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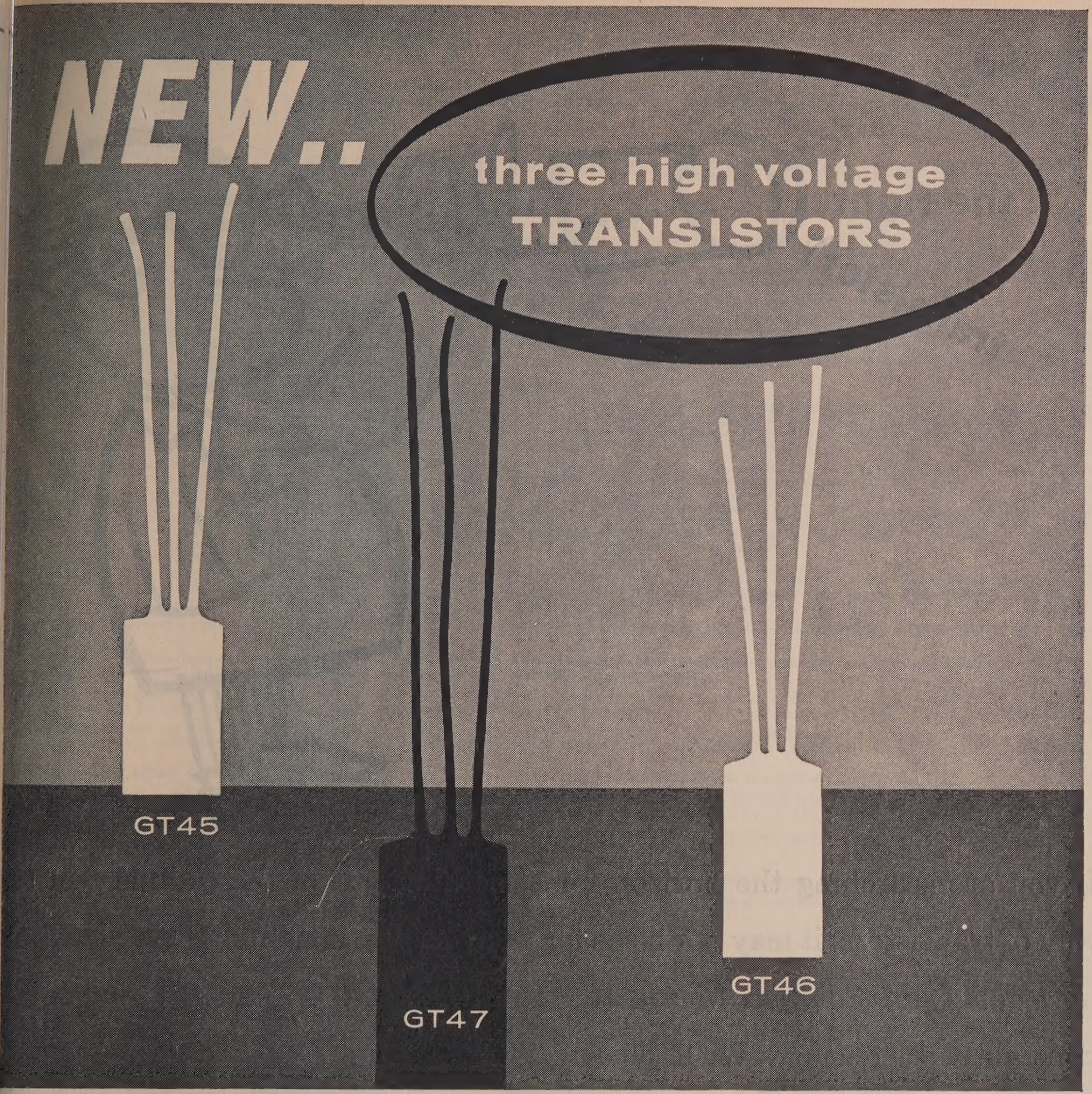

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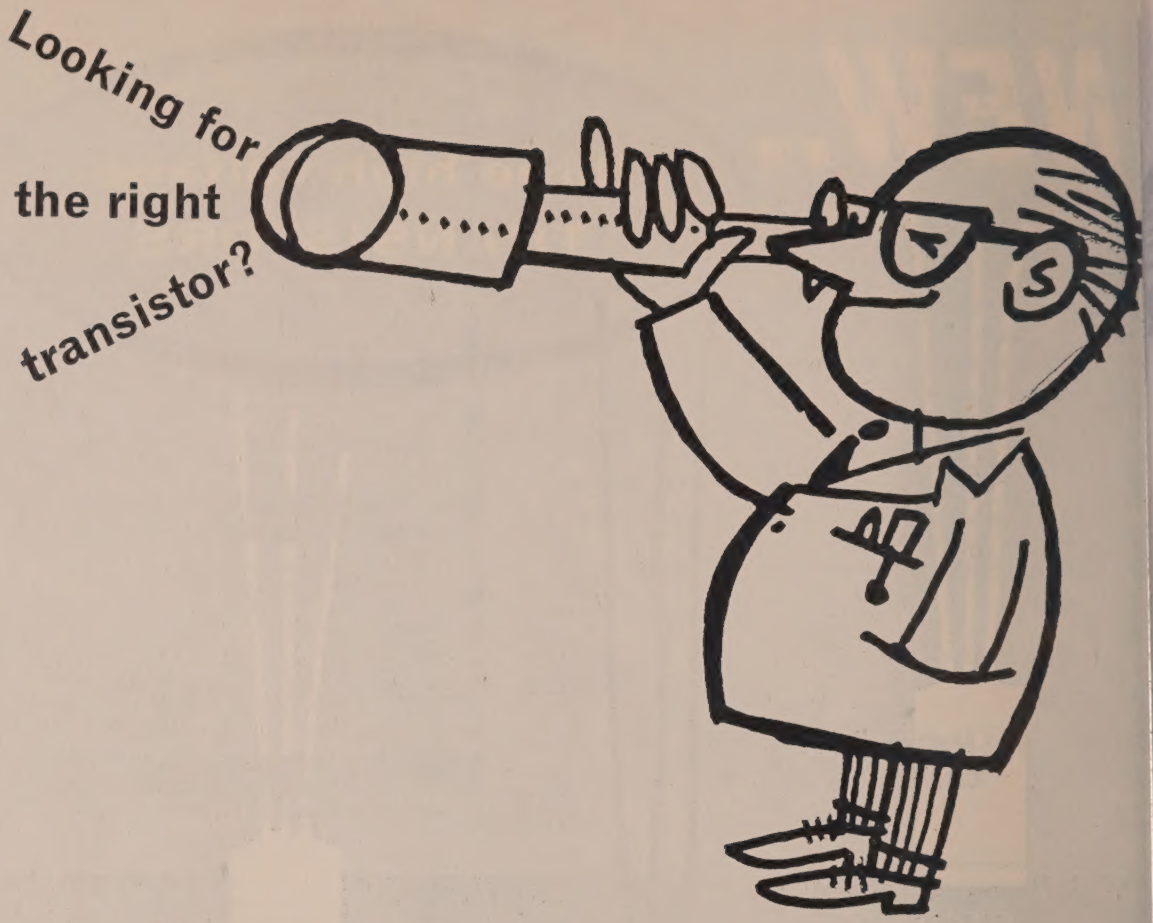
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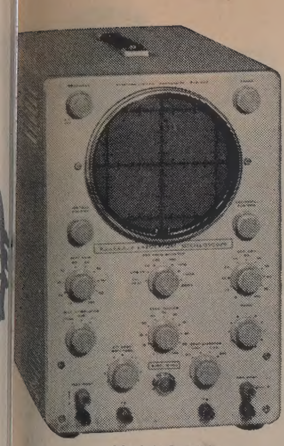
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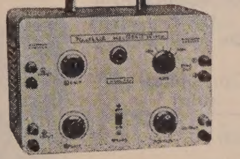
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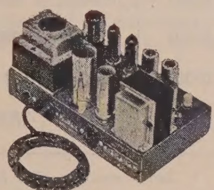
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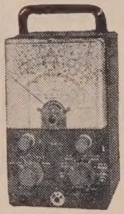
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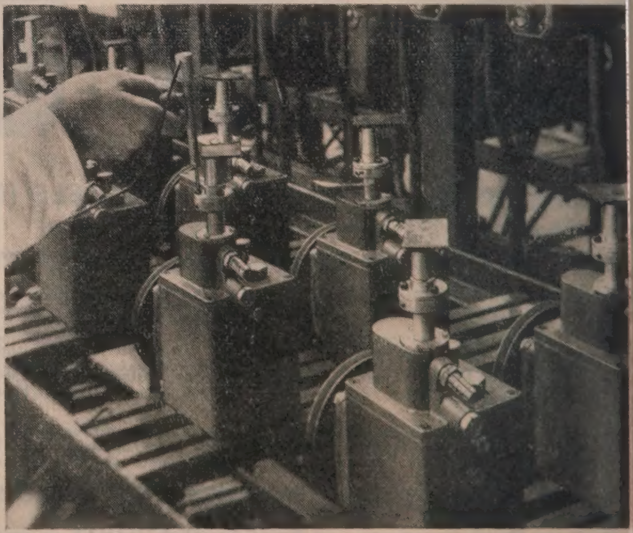

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16511 CANONICAL AND HAMILTONIAN FORMALISM APPLIED TO THE STURM—LIOUVILLE EQUATION.
.Biot and I.Tolstoy.
rt. appl. Math., Vol. 18, No. 2, 163-72 (July, 1960).

The Sturm—Liouville equation is expressed in Hamiltonian n. A simple generating function is derived which defines a large s of canonical transformations and reduced the Sturm—Liouville ation to the solution of a first order equation with a single unwn. The method is developed with particular reference to the e equation. The procedure unifies many apparently diverse tments and leads to new insights and procedures. Some new sformations are obtained, useful in the turning point region and the improvement of accuracy in the region of validity of W.K.B. tions. In addition a new power series expansion near the turnpoint is obtained.

518 : 621.374.32

16512 CIRCUITS TO INCREASE THE SPEED OF CARRY PROPAGATION IN PARALLEL ADDERS. L.Dadda.
vo Cimento Suppl., Vol. 15, No. 2, 169-80 (1960). In Italian.

The problem of carry propagation in parallel adders for digital computers is outlined. Various methods proposed and used to reduce the delay in carry propagation are discussed. A new method is described that uses switching elements which behave like relays, e.g. transistors. H.Morrison

518 : 681.142

16513 APPARATUS FOR THE STUDY OF ALGORITHMS OF ROAD TRAFFIC MOVEMENT.
S.V.Yablonskii, A.M.Gil'man, I.V.Kotel'nikov and P.M.Potȳlitsȳn.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 78-81 (May 1, 1960).
In Russian.

A description of a model which was constructed to represent a simple crossroads, i.e. an intersection of two two-way roads, controlled by four-colour traffic lights. Eight lanes (of left-turning and straight-through vehicles, right-turns not being controlled) approaching the crossing, are represented by eight generators of either random pulses or pulses from punched tape taken from an actual crossroads. The "vehicles" are counted by eight four-stage reversible binary counters. A computer can be set for various requirements, such as minimum waiting time of vehicles, etc. Operation of the model is displayed on a lighted panel. F.Quelon

519

16514 GENERALIZATION OF THE LAGRANGE EXPANSION WITH APPLICATION TO PHYSICAL PROBLEMS.
P.A.Sturrock.
J. math. Phys. (New York), Vol. 1, No. 5, 405-8 (Sept.-Oct., 1960).

Certain problems of fluid dynamics are conveniently discussed in the Lagrangian description by means of the displacement-vector function. The Eulerian variables describing the motion may be obtained from the displacement-vector function by a generalization of the Lagrange expansion which is here established. Two examples of the application of this expansion are given; the derivation of the Fokker—Planck equation, and the description of the surface conditions of a rippling electron stream by the device of equivalent surface charges.

ASTROPHYSICS

522.5 : 535.24

16515 A WOLLASTON PHOTOMETER.
T.Gehrels and T.M.Teska.
l. Astron. Soc. Pacific, Vol. 72, 115-22 (April, 1960).

A description, with constructional details, is given of a new toelectric polarization-photometer designed for use with the inch telescope of the McDonal Observatory, Texas, U.S.A. The trument was designed to operate at a series of wavelengths in range 3500-9900 A. A quartz depolarizer is employed giving stantially 100% performance at all wavelengths. The Wollaston sm, 1.05 inches in diameter, is made of calcite cemented with yl methacrylate to give full transmission down to 2900 A. Divergces of ordinary and extraordinary rays are, respectively, 12.9 11.2 degrees at 3500 A; and 10.4 and 9.3 degrees at 10 000 A. polarization measurements are not affected by the presence of clouds. D.R.Barber

522.5 : 535.41

16516 THE USE OF THE FABRY—PEROT INTERFEROMETER IN ASTRONOMY. J.Ring and N.J.Woolf.
hys. Radium, Vol. 19, No. 3, 354-7 (March, 1958). In French.

The Fabry—Perot interferometer is compared with the diffraction grating and its astronomical uses at three different resolving powers are discussed. (1) Monochromatic photography through interference filters. A description is given of two optical systems designed to increase the photographic speed of a large telescope whilst correcting its aberration. (2) Photoelectric spectrometry of stars with $R \cong 5000$. The gain in luminosity is shown to depend on seeing conditions. An interferometer is described which uses high-pressure scanning and gases of high refractivity. (3) Design of a spectrometer for $R \geq 100\,000$ using a grating and a Fabry—Perot scanned simultaneously by pressure; the technique of photon counting is recommended.

525

16517 SOME VISTAS OF ASTRONOMICAL DISCOVERY.
W.W.Morgan.
Science, Vol. 132, 73-5 (July 8, 1960).

523

16518 PROBLEMS OF ASTRONOMICAL SPECTROSCOPY.
P.Swings.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1960, No. 2, 21 pp.
Survey article.

523

16519 SPACE SCIENCE SYMPOSIUM.
S.F.Singer.

Amer. J. Phys., Vol. 28, No. 7, 612-13 (Oct., 1960).

Held in connection with the Annual Meeting of the American Association of Physics Teachers at New York, on January 29, 1960. Remarks made by the chairman in introducing the participants.

523

16520 COSMICAL ELECTRODYNAMICS.
H.Alfvén.

Amer. J. Phys., Vol. 28, No. 7, 613-18 (Oct., 1960).

A review is given of the development in the field of cosmical electrodynamics. It is mentioned that the great interest in thermonuclear research has produced a considerable progress in plasma physics. This is of astrophysical interest because it is now possible to check the theories of a plasma by experiment. As an example a recent experiment in a "homopolar" machine is discussed, and its importance to the theory of the origin of the solar system is emphasized. Conclusions about the origin of the solar system are drawn. In particular, the mechanism by which Saturn's ring has been produced is discussed. It is further pointed out that the moon probably was born as a planet later captured by the earth.

523

16521 PROCEEDINGS OF THE THIRD SYMPOSIUM ON COSMICAL GAS DYNAMICS.

Edited by J.M.Burgers and R.N.Thomas.

Rev. mod. Phys., Vol. 30, No. 3, 906-1108 (July, 1958).

For abstracts see Abstr. 985-93, 1136, 1602-4, 2000-2, 2018, 3041 of 1959; 8470, 8478, 8511, 10474, 10476, 10482, 10513-25, 10872, 11501 of 1960.

523

16522 THE INTERPRETATION OF COSMOLOGY.
W.H.McCrea.

Nature (London), Vol. 186, 1035 (June 25, 1960).

An uncertainty, which increases with distance, arises in cosmology as a consequence of the finite velocity of light. The difference between the predictions of the evolutionary and steady-state theories is of the same order as the uncertainty (Abstr. 11716 of 1959).
G.A.Chisnall

523

16523 STEADY-STATE COSMOLOGY TREATED ACCORDING TO GENERAL RELATIVITY. W.Davidson.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 309-24 (1959).

The interpretation of steady-state cosmology according to general relativity, initiated by McCrea (Abstr. 5010 of 1951), is extended by the investigation of external and internal metrics for the static superposition of a spherically symmetric mass concentration, or rarefaction, in a "steady-state" medium. It is found that a constant total density ρ_0 and negative pressure ρ_0 $(=-\rho_0)$ appear to constitute a natural state of relative stability for the steady-state medium, and the analysis suggests that this state may be realized between the galaxies of a steady-state universe. From a discussion of the world-lines of the medium in the neighbourhood of a static disturbance it is deduced that such a disturbance has the effect of countering cosmic repulsion, or intensifying it, according as it represents a concentration of mass, or a rarefaction, relative to the natural state. A mechanism for the creation of matter is presented by which the rate of creation is seen to be strongly dependent on local gravitational influence, being positive where the medium is expanding, and negative (annihilation) where it is contracting. Physical limits of size and density are found for a static disturbance of the natural state. It is shown that in a disturbed medium the sign of the gravitational field depends on the local state of the medium, and in a rarefaction the density of inertia, in the Newtonian sense, is found to be negative. A theoretical basis for the relative stability of the natural state is indicated.

523.16

16524 SOLAR RADIO EMISSION AT 9500 Mc/s. I. A POLARIMETER IN THE MICROWAVE REGION. K.Akabane.

Ann. Tokyo Astron. Obs. Univ. Tokyo, Vol. 6, No. 2, 57-64 (1958).

The method of phase modulation at the r.f. circuit is applied to detect the polarized components in the incident waves. Amplitude modulation by ferrite switching is also used to obtain higher observational accuracy. The Stokes parameters (I, Q, U, and V) in a partially incident wave can be obtained directly. The minimum detectable intensities of these parameters are 3 for I + Q/2 and V, and V, and 6 for Q and U respectively in the units of 10^{-22} m.k.s.

523.16 : 621.3

16525 A THEORY OF RADAR SCATTERING BY THE MO
T.B.A.Senior and K.M.Siegel.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 3, 217-29 (May-June, 1

A theory is described in which the moon is regarded as a "quasi-smooth" scatterer at radar frequencies. A scattered p is then composed of a number of individual returns each of whi is provided by a single scattering area. In this manner is it po to account for all the major features of the pulse, and the evide in favour of the theory is presented. From a study of the meas power received at different frequencies, it is shown that the scattering area nearest to the earth is the source of a specular return, and it is then possible to obtain information about the m of which the area is composed. The electromagnetic constants derived and their significance discussed.

523.16 : 621.3

16526 RADIO FREQUENCY SCATTERING FROM THE SU FACE OF THE MOON.

R.L.Leadabrand, R.B.Dyce, A.Fredriksen, R.I.Presnell and J.G.Schlobohm.

Proc. Inst. Radio Engrs, Vol. 48, No. 5, 932-3 (May, 1960).

Observations using a high-power 400 Mc/s radar show tha the moon behaves not only as a diffuse reflector but also as a diffuse scatterer. In addition to the strong signal returned fro the central region of the lunar surface weak transient echoes a observed from the entire lunar surface within view of the eart
C.Ha

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16527 THE RADIO EMISSION FROM NORMAL GALAXIES I. OBSERVATIONS OF M31 AND M33 AT 158Mc/s 237 Mc/s. R.H.Brown and C.Hazard.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 297-308 (1959)

A survey of the radio emission from bright normal galaxie been carried out at 158 Mc/s. Results obtained on M31 and M3 reported. The integrated radio magnitude (m_r) of these two gal has been measured and compared with their photographic magn (m_p); it is found that the difference (m_r-m_p) is almost the sam both. The distribution of intensity across M31 shows two majo components: a disk and a corona. The corona is responsible fo 90% of the total emission, has a true axial ratio of about 0.6, an has a major axis which is about three times greater than that o visible nebula. The results show that M33 also has a corona; th ellipticity, emissivity and dimensions of the corona relative to visible object are closely similar to the values found for M31. comparison between M31, M33 and the Galaxy suggests that the emissivity of the corona of the Galaxy is significantly higher th that of the other two galaxies.

523.16 : 5

16528 THE RELATION OF COSMIC RADIO EMISSION TO ELECTRONIC COMPONENT OF COSMIC RAYS.

H.Tunmer.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 2, 184-93 (1959).

The similarity between the spectra of cosmic rays and of t relativistic electrons responsible for cosmic radiowaves sugge that the electrons may derive from the collisions of primary cos rays with the interstellar gas. The relation to be expected fron this process is examined, and it is shown that the form of the electron energy spectrum is determined primarily by the differ losses which prevail for different parts of the electron energy spectrum. It is found that the observed spectra of various diffe types of radio source agree with the theoretical spectra, and th it is possible to obtain information on various physical conditio in the radio sources.

523.16 : 621.39

16529 MAXIMUM ANGULAR ACCURACY OF TRACKING A RADIO STAR BY LOBE COMPARISON. R.Manass

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 50-6 (Jan., 1960).

A general expression is derived for the maximum angular accuracy of tracking a radio star by lobe comparison (or monop This angular accuracy depends on the input signal-to-noise ratic the wavelength, the time—bandwidth-product of signal integratior and the effective length of the aerial aperture. The maximum ar accuracy can be obtained, approximately, by performing a simpl correlation of odd and even components of the aerial output. Angular accuracy formulae for simple dishes or for interferome appear as special cases of the general result. An appendix disc e interferometer technique in more detail, and the angular accuracy or the data processing technique used by Ryle (Abstr. 2359 of 1952), s compared with that obtained from the optimum processing.

523.16

16530 THE BRIGHTNESS DISTRIBUTION WITHIN THE RADIO SOURCES CYGNUS A (19N4A) AND CASSIOPEIA (23N5A). R.C.Jennison and V.Latham.

onthly Not. Roy. Astron. Soc., Vol. 119, No. 2, 174-83 (1959).

Measurements are described of the amplitude and phase of the ourier transform of the distribution of brightness at 127 Mc/s ithin the intense radio source Cygnus A (19N4A) and Cassiopeia (23N5A) along an axis in the East—West direction. The bright-ess distribution is computed from the observed readings and in the ase of Cygnus A is shown to confirm the existence of two major mitting regions of almost equal intensity. The α component, eading in right ascension, is slightly brighter than the β component. easurements are also described of the determination of the posi-on of the major axis of the source. It is evident that the diameter f the Cygnus source in a position angle close to 187° must be elatively very small. The measurements on Cassiopeia indicate e presence of a faint spur near position angle 90° together with robably slight limb brightening of the main body of the source.

523.16 : 551.5

EFFECT OF LINE-OF-SIGHT AURORA ON RADIO STAR CINTILLATIONS. See Abstr. 16465

523.3 : 525

16531 NUMERICAL PROBLEMS OF CONTEMPORARY CELESTIAL MECHANICS. Z.Kopal.

rontiers of numerical mathematics symposium, Wisconsin, 1959 see Abstr. 12232 of 1960), Paper Three, p. 45-53.

Surveys some of the problems of motion of the moon and of rtificial satellites and lists the order of magnitude of some of the ore important quantities arising in such problems.

H.N.V.Temperley

523.4

16532 THE PHYSICAL STATE OF CONDENSED MATTER AND THE RADIUS OF A COLD PLANETARY BODY. P.Singh and N.S.Goel.

. Astrophys., Vol. 50, No. 4, 269-77 (1960).

The physical state of matter in a cold planetary body has been vestigated in the light of Bohm—Pines' theory of plasma oscilla-ons in metals. It has been shown that the radius of a planet depends the degree of ionization (this expression is used here to specify ose electrons which can move from atom to atom in a metallic lid) of the condensed matter. The logarithms of the calculated dii of various planets are plotted against the logarithm of the mass the planet expressed as a fraction of solar mass. A comparison the calculated and observed radii gives an idea of the mean mole-ular weight or the degree of ionization and hence also of the inter-l composition.

523.4

16533 SURFACE CONDITIONS ON THE NEAREST PLANETS. E.J.Öpik.

mer. J. Phys., Vol. 28, No. 7, 618-22 (Oct., 1960).

A review, chiefly of the more controversial problems relating the surface structure of the moon, Mars, and Venus. The task similar to that of solving a crossword puzzle; the answer must ree with, or at least not contradict, all the existing data. In many spects the conclusions differ from those conventionally accepted d quoted in standard textbooks.

523.4

16534 SOME REMARKS ON OPTICAL PROPERTIES OF SATURN'S RINGS. M.S.Bobrov.

stron. J., Vol. 65, No. 5, 337-8 (June, 1960).

Some optical properties of Saturn's rings are discussed in nnection with the papers of Franklin and Cook (1958). Special tention is paid to the objection of these authors to Bobtov's con-lusion about nondiffractional character of the light scattering by -ring. It is shown that this objection is unfounded.

523.4

16535 MICROWAVE ABSORPTION AND EMISSION IN THE ATMOSPHERE OF VENUS. A.H.Barrett.

geophys. Res., Vol. 65, No. 6, 1835-8 (June, 1960).

Radio brightness temperatures were calculated in the wavelength nge 0.1 to 10 cm for the following model of the atmosphere of Venus: surface temperature 580°K, surface pressure 1.5 atm, adiabatic equilibrium below cloud level and isothermal equilibrium at 285°K above. Constant compositions of 75% CO_2, 22-25% N_2, 0-3% H_2O were assumed. With no water, the cloud level is 33 km, the pressure at this level is 5.7×10^4 dynes/cm^2, adiabatic temperature gradient 9 deg K/km and the isothermal scale height 6.86 km. Calculated brightnesses are insensitive to N_2 content and except near to H_2O resonances are insensitive to conditions above the cloud layer. Further descriptions and calculations are to follow.

D.H.Gilbey

523.5

16536 THE DEPENDENCE OF THE STRUCTURE OF SIDEROLITES ON THEIR CHEMICAL COMPOSITION. A.A.Yavnel'.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 5, 1049-52 (April 11, 1960). In Russian.

The relationship between the structure (width of kamacite beams) of Ni-containing siderolites and their Ni content is expressed by a curve [(Chirvinskii, Meteoritika, Vol. 5, 39 (1949); Buddhue, Popular Astronomy, Vol. 54, No. 3, 149 (1946)] or a band [(Perry, "The Metallography of Meteoric Iron", Washington (1944)] of characteristic shape. Four bands whose combination yields almost Perry's band are obtained by the author for Ni-containing siderolites with 4 successive ranges of Ga—Ge content.

F.Lachman

523.72

16537 ABUNDANCE OF LITHIUM AND ORIGIN OF THE SOLAR SYSTEM. T.Gold.

Astrophys. J., Vol. 132, No. 1, 274-5 (July, 1960).

To account for the fact that the solar surface has a lower relative abundance of Li than is found in the planets, whilst the reverse holds for the T Tauri stars (Bonsack and Greenstein, Astrophys. J., Vol. 131, No. 1, 83, Jan., 1960) the suggestion is reviewed that the planets were once part of the sun, and were formed from material shed in the form of a relatively thin, outer shell. At an early age the sun would lose its magnetic energy with the formation of a T Tauri type Li-enriched outer atmosphere: this was the material from which the planets subsequently condensed. If all stars go through the T Tauri stage at some stage of their evolution and shed their outer envelope in a manner similar to that envisaged for the sun, it should be possible to detect spectroscopically a small-scale stellar nebula representing the solar system in its early phase before the planets were formed.

D.R.Barber

523.72

16538 ELECTROMAGNETIC RADIATION FROM EXTRA-TERRESTRIAL SOURCES. H.Friedman.

Amer. J. Phys., Vol. 28, No. 7, 622-6 (Oct., 1960).

Rocket astronomy has mapped the spectrum of the sun from the ground level cutoff at 3000 A down to X-ray wavelengths as short as 0.1 A. The X-ray emissions are strongly dependent on solar activity with greatly enhanced intensities accompanying solar flares. Photographs from rockets have revealed the disk distribution of ultraviolet emission. The first measurements of ultraviolet light of the night sky have discovered the existence of extended ultraviolet nebulosities surrounding hot stars and a bright diffuse glow of Lyman-α radiation scattered from neutral hydrogen in space.

523.72

16539 MEASUREMENTS MADE OF HIGH-ENERGY X-RAYS ACCOMPANYING THREE CLASS 2^+ SOLAR FLARES. T.A.Chubb, H.Friedman and R.W.Kreplin.

J. geophys. Res., Vol. 65, No. 6, 1831-2 (June, 1960).

Rocket measurements of solar X-radiation accompanying three S.I.D. flares in Aug.-Sept. 1959, indicated a large influx of energy > 20 keV during the lifetime of each flare. Total energy (at the top of the atmosphere) corresponded to $\sim 4.5 \times 10^{-6}$ erg/cm^2/sec. Control experiments established that no X-rays of energy >20 keV were observed in the absence of flares.

D.R.Barber

523. 72 : 551.5

COUPLING OF THE SOLAR WIND AND THE EXOSPHERE. See Abstr. 16456

523.74

16540 THE OBSERVATION OF SOLAR GRANULATION FROM A MANNED BALLOON. I. OBSERVATIONAL DATA AND MEASUREMENT OF CONTRAST. D.E.Blackwell, D.W.Dewhirst and A.Dollfus.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 2, 98-111 (1959).

There appears to be a practical limit to the resolution attainable in solar photography from a ground station. In an attempt to obtain greatly improved resolution, photographs have been made with a 29 cm refracting telescope mounted underneath the nacelle of a manned balloon at a height of 18 000 ft. Two flights were made; during the second flight on 1957 April 1, 480 frames were exposed. Although the ground seeing during the flight was very poor, the photographs taken with the balloon-borne telescope during this second flight are superior to the best that have been secured at any ground station. The complex structure of the photosphere is illustrated by photographs. Autocorrelation curves for two scans across the best photograph are given. The contrast transmission functions for the complete telescope (objective, eyepiece, photographic emulsion) have been measured using sinusoidal gratings, and the results used to correct microphotometric measurements of contrast. The corrected mean contrast between granules and intergranular regions is 40% at a wavelength of 5300 A.

523.74

16541 A SUNSPOT CYCLE MODEL.
C.W.Allen.

Observatory, Vol. 80, 94-8 (June, 1960).

The model seeks to explain the principal features of the 11 yr sunspot cycle by postulating interactions between the individual spot fields and the so-called general magnetic field of the sun. Basic requirements are: (1) a poleward surface current carrying the magnetic regions to higher latitudes during the course of the cycle; (2) a Bjerknes-type circulation with a systematic segregation of magnetic polarity in the sunspot zones. Experimental evidence from Plaskett (1959), Spörer (1894) and Tuominen (1952, 1955) supports requirement (1), but (2) needs independent confirmation before the model can be confidently adopted.

D.R.Barber

523.75

16542 SOLAR LIMB SURGES ACCOMPANIED BY X-RAY EMISSION.
J.Kleczek and L.Křivský.

Nature (London), Vol. 186, 1035-6 (June 25, 1960).

Observations made at Ondrejov, Czechoslovakia in the period, May-August, 1959, showed a marked coincidence in time between sudden enhancements of atmospherics at 27 kc/s with the appearance of bright solar limb (H_α) surges. The latter are probably connected with H_α emission in the underlying chromosphere, and the sudden enhancement is caused, most probably, by X-radiation from the overlying coronal region.

D.R.Barber

523.75

16543 THE STRUCTURE OF THE ACTIVE CHROMOSPHERE.
M.Waldmeier.

Z. Astrophys., Vol. 50, No. 4, 225-32 (1960). In German.

The structures in the active chromospheric regions, the so-called mushrooms, show an average height of 11 000 km and a diameter of 2000-3000 km. Their mean lifetime is 10 min and their mean ascending velocity 25 km/sec. They are bigger than the structures of the undisturbed chromosphere, the so-called spicules, but smaller than the surges. On the solar disk they appear as bright points or as microflares.

523.77

16544 INTERFEROMETRIC TECHNIQUES IN SOLAR OBSERVATIONS.
P.J.Treanor.

J. Phys. Radium, Vol. 19, No. 3, 260-1 (March, 1958). In French.

Problems involved by the use of Fabry–Perot interferometer in solar spectroscopy are reviewed; application to the chromosphere is emphasized. Difficulties arise from the fact that the chromosphere is an extremely narrow and relatively faint layer, some 10 seconds of arc in breadth, bordering the extremely bright and scintillating solar limb. The presence of a heavy scatter spectrum creates difficulties analogous to these encountered in photospheric interferometry and overcome in a similar way. Fringe systems of H_α, H_β, D_3 and H and K calcium lines were obtained, and the profile of the He line 5876 A was studied with an effective resolving power of 10^5. A small Hilger spectrograph with a very narrow slit was used in series with a Fabry–Perot etalon. The slit was placed tangentially to the solar limb; the resulting stitch-like fringes, crossing the whole of the chromosphere, contain a complete account of the variation of the profile with height. Relatively simple methods have been developed for the accurate photometric analysis and interpretation of this type of fringe system, and these may prove of interest in the interferometric observation of other non-uniform sources.

16545 ROCKET AND SATELLITE OBSERVATIONS OF T SOLAR ULTRA-VIOLET SPECTRUM.
R.G.Athay

Nature (London), Vol. 186, 1036 (June 25, 1960).

The Lyman series of H in the solar spectrum are of two-f importance because they serve both as sources of ultraviolet ionizing radiation affecting the ionosphere, and as aids to a det study of the solar atmosphere. Theoretical reasons are here advanced to emphasize the necessity for obtaining observationa data on the Lyman-β line as a valuable supplement to the data already collected from studies of the stronger Lyman-α radiat

D.R.B

16546 PRESSURE BROADENING OF THE SOLAR BALMI LINES.
R.Cayrel and G.Traving.

Z. Astrophys., Vol. 50, No. 4, 239-52 (1960). In German.

The wings of $H_\alpha - H_\delta$ and their centre–limb variation hav calculated assuming a homogeneous model of the solar photosp and three different broadening mechanics: (a) purely statistica broadening (Holtsmark); (b) Holtsmark theory plus electron co according to Kolb and Griem (Abstr. 1273 of 1959); (c) taking resonance broadening into account. It turned out that the inclu of electron collisions markedly improved the agreement with observed profiles and that at least for H_α the influence of reso broadening is also important. Furthermore, comparison with observation indicates that in earlier measurements (De Jager, one had apparently assumed at H_γ and H_δ a position of the cont too low by about 5%. The influence of temperature inhomogene which was neglected in the numerical calculation, has been est One should expect that the depth of the wings increases only s if $\Delta T/T$ is of the order of ±5%, a value supported by recent me ments of the granulation.

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16547 VOIGT FUNCTIONS IN THE DESCRIPTION, CORR TION AND INTERPRETATION OF FRAUNHOFER LINE PROFILES.
G.Godoli and M.Santoro.

Atti. Fond. Ronchi, Vol. 15, No. 4, 421-30 (July-Aug., 1960). Italian.

The properties are summarized of Voigt functions. It is s how these functions can represent the correct profiles of the F hofer lines and the instrument profiles. The use is discussed Voigt functions for the correction of the observed profiles and the deduction of the physical parameters of the solar atmosphe

523.82 :

16548 THEORY OF ASTRONOMICAL SCINTILLATION.
H.Elsässer.

Z. Astrophys., Vol. 50, No. 4, 278-95 (1960). In German.

For Pt I, see Abstr. 2085 of 1960. Scintillation phenomena discussed on the basis of a diffraction theory. Starting with a s tion of the wave-equation of Obuchow, formulae for the r.m.s. f tuation in brightness and direction of visible starlight are deriv Comparison with Pt I shows that geometrical and wave theory identical results for the changes in direction (seeing). In the ca of the brightness scintillation the geometrical approximation is valid for stars near the zenith, whereas diffraction effects cann neglected near the horizon. The variation of scintillation with increasing zenith distance can be explained only by the combine effect of turbulent eddies with various sizes. From the measur dependence of the seeing on the zenith distance it follows that th correlation between the fluctuations in the refractive index and dimensions of the eddies differ from the lower to the upper atm pheric layers. The increase of the brightness scintillation with zenith distance depends strongly upon the telescope's aperture accordance with the observations.

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16549 MASS–LUMINOSITY RELATION.
R.Kurth.

Z. Astrophys., Vol. 50, No. 4, 253-7 (1960). In German.

Mainly by dimensional arguments, two plausible asymptotic relations (for very small and very large stellar masses) are de and briefly compared with the empirical relations.

5

16550 Be STARS IN GALACTIC CLUSTERS.
A.J.Meadows.

Astron. J., Vol. 65, No. 5, 335-6 (June, 1960).

The proportion of Be to B stars is considered for ten gala ers. It is shown that this ratio is considerably higher in some e clusters than for the galaxy as a whole. It is suggested that erabundance of Be stars indicate higher than average rotational cities for all the B stars in the cluster.

523.85 : 538.3

THE MAGNETIC AND DYNAMICAL FIELDS OUTSIDE A TO-STAR. See Abstr. 17090

523.87

5551 ONE POSSIBLE ESTIMATION OF THE TEMPERATURES OF HOT STARS ACCORDING TO THE CHARACTER OF IR NIII EMISSION SPECTRUM. A.A.Nikitin.

. Akad. Nauk SSSR, Vol. 132, No. 1, 89-90 (May 1, 1960). ssian.

Of the two groups of N III emission lines observed in Wolf–Rayet s and in some novae and planetary nebulae, the second can arise under a certain condition, which is formulated and shown to be erature dependent. This suggests that stars which show intense of the second group have temperatures in the range 10^5 to 10^5 degrees. G.A.Chisnall

523.87 : 535.41

6552 A STUDY OF INTERSTELLAR EMISSION WITH THE AID OF A FABRY–PEROT ETALON. G.Courtès.

hys. Radium., Vol. 19, No. 3, 342-5 (March, 1958). In French.

Interferometric observations already published permit the pler–Fizeau, effect in the faintest galactic nebulae having more 3' apparent diameter to be obtained with a 120 cm telescope. equivalent slit width on the sky must be 0.5" with a 195 cm scope. With the same instrument a new optical arrangement g a small exit pupil is able to reach nebulae of 20" apparent neter, with an accuracy of 3 km/s. Description of a monomatic radiation selector giving direct photographs of the ulae in one monochromatic radiation such as H_α or [N II] the possibility of obtaining directly the picture of the nebula given radial velocity. An experiment to test the continuity ne multilayers used is given.

523.87 : 535.41

16553 A STUDY OF STELLAR SPECTRAL LINES BY INCLINING A FABRY–PEROT INTERFEROMETER.

Geake and W.L.Wilcock.

hys. Radium, Vol. 19, No. 3, 346-50 (March, 1958). In French.

Tests are described of an arrangement for the direct phototric recording of stellar spectra, using a Fabry–Perot etalon ombination with a prism monochromator. The addition of the on allows the monochromator to be used with a wider entrance for given wavelength resolution: this results not only in a gain ght, but also in a reduction of the fluctuations caused by the ion of the stellar image under the influence of atmospheric ulence.

523.87 : 539.18

LABORATORY HIGH-EXCITATION RELATIVE f-VALUES R TITANIUM I. See Abstr. 15666

523.877

16554 SOME REMARKS ON THE PULSATING GAS SPHERE. R.Kurth.

Astrophys., Vol. 50, No. 4, 258-68 (1960). In German.

The usual equation of motion of a pulsating gas sphere is rected. An integration theory is outlined which can be used er for predicting the pulsations produced by some physical cause or analysing the observed pulsations. It provides some necessary conditions for the assumptions about both the physical cause of the pulsations and the structure of the gas sphere in the state of equilibrium. The problems of the asymmetry of the pulsations, the length of their periods and the phase lag can adequately be dealt with the linear theory. A programme for further investigations is sketched.

525

16555 CONTINENTALITY AND THE GRAVITATIONAL FIELD OF THE EARTH. W.H.Munk and G.J.F.MacDonald.

J. geophys. Res., Vol. 65, No. 7, 2169-72 (July, 1960).

Satellite observations provide some information about zonal harmonics J_2, J_3, ... J_6 of the gravitational field. For a hydrostatic earth (all surfaces of equal density are level), odd harmonics vanish and even harmonics can be computed from precession and geophysical data. The nonhydrostatic (observed minus hydrostatic) harmonics have been compared with those calculated for the known distribution of continents and some reasonable assumptions about density in the crust. The two sets of values do not agree, and this raises the possibility that density variations in the mantle, perhaps unrelated to the distribution of continents, are the important factor in determining the gravitational coefficients of low order.

525

16556 A GENERAL METHOD FOR AN EXPLICIT DETERMINATION OF THE SHAPE OF THE EARTH FROM GRAVIMETRIC DATA. A.Bjerhammar.

K. Tekn. Högsk. Handl., No. 149, 9 pp. (1959).

525

16557 RADIOASTRONOMICAL OBSERVATIONS OF THE SECOND SOVIET COSMIC ROCKET.

V.V.Vitkevich, A.D.Kuz'min, R.L.Sorochenko and V.A.Udal'tsov.

Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 85-8 (May 1, 1960). In Russian.

Details of the interference methods used to observe the second Soviet rocket. The angular coordinates of the container of the scientific apparatus are found at the moment of impact with the moon. The intensity of the signal received (at 183.6 Mc/s) and its variation with time are determined. G.A.Chisnall

525 : 523.3

PROBLEMS OF MOTION OF ARTIFICIAL SATELLITES. See Abstr. 16531

525 : 551.5

UPPER ATMOSPHERE AND SPACE EXPLORATION WITH ARTIFICIAL SATELLITES. See Abstr. 16419

525 : 538. 3

DAMPING OF THE SATELLITE WAKE IN THE IONOSPHERE. See Abstr. 15129

525 : 538.56 : 551.5

USE OF GEOSTATIONARY SATELLITES FOR THE STUDY OF IONOSPHERIC RADIO-WAVE PROPAGATION. See Abstr. 16427

525 : 538.56

HIGH FREQUENCY FADING OBSERVED ON THE 40 Mc/s WAVE RADIATED FROM ARTIFICIAL SATELLITE 1957α. See Abstr. 15172

525 : 539.1.07 : 621.387.424

RADIATION INSTRUMENTATION ELECTRONICS FOR THE PIONEERS III AND IV SPACE PROBES. See Abstr. 15184

PHYSICS

GENERAL

53

16558 THE TWO ASPECTS OF SCIENCE.
G.P.Thomson.

Nature (London), Vol. 187, 837-41 (Sept. 3, 1960).

Presidential address to the British Association. Besides seeking to control nature, scientists seek to understand the nature of things by first studying details and then using them to form concepts. The two aspects are not in conflict; the technologist helps the pure scientist by developing better and cheaper instruments and by showing that very abstract concepts have counterparts in the real world. Recent developments in quantum theory are discussed. The behaviour of individual electrons is almost always strange, but the "billiard-ball" concept of an atom is still valid for many purposes. The lack of determinism is not peculiar to quantum theory but was already noticeable, e.g., in the kinetic theory of gases. The laws governing elementary particles seem to consist of various "generalized conservation laws". The fact that so many of the laws of nature involve small whole numbers seems to be of absolutely fundamental significance, and may have implications for biology as well as physics and chemistry. H.N.V.Temperley

53

16559 A FORERUNNER OF TWENTIETH CENTURY PHYSICS. A RE-VIEW OF LARMOR'S "AETHER AND MATTER".
L.L.Whyte.

Nature (London), Vol. 186, 1010-14 (June 25, 1960).

It is emphasized that Larmor, working with the facts and theories of 1894-8, could use basic principles to provide comments on fundamental theory which are still valid. Attention is drawn to his recognition of the need for a characteristic length providing definiteness of scale in atomic theory; the role of chiral properties; the existence of pure numbers of importance for fundamental theory, and the compatibility of micro-indeterminacy with macro-determinacy. Larmor was able effectively to identify the fine structure constant, even before the discovery of Planck's constant, because the former has geometrical and kinematic, as well as dynamic, consequences. R.A.Newing

53

16560 MICHAEL FARADAY AND THE EVOLUTION OF THE CONCEPT OF THE ELECTRIC AND MAGNETIC FIELD.
L.P.Williams.

Nature (London), Vol. 187, 730-3 (Aug. 27, 1960).

Text of evening discourse at the Royal Institution.

53

16561 RUBBER MODEL FOR DEMONSTRATIONS AND LABORATORY EXPERIMENTS. C.B.Cooper.

Amer. J. Phys., Vol. 28, No. 7, 644-5 (Oct., 1960).

Use of the rubber membrane model as a teaching aid is discussed, both for elementary lecture demonstrations and for intermediate laboratory experiments. The model can be used to demonstrate directly and vividly by analogy two-dimensional potential fields, and trajectories of particles moving in these fields.

53

16562 ON DIMENSIONAL ANALYSIS.
R.E.Thun.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 349-56 (July, 1960).

The dimensions of physical quantities q are interpreted as vectors

$$q_i(\gamma_{i1}, \gamma_{i2}, \ldots, \gamma_{in}) \equiv \gamma_{i1} b_1 + \gamma_{i2} b_2 + \ldots + \gamma_{in} b_n ,$$

where the basic elements b_j generating the vector space represent the basic quantities of the dimensional system and the coefficients γ_j are defined by

$$q_i = \prod_{j=1}^{n} b_j^{\gamma_{ij}} .$$

The interpretation permits the application of the theorems on vector spaces to dimensional analysis. Some results of this approach are simplified rules for the transformation of dimension and unit systems and a physically more transparent derivation of a complete set of dimensionless products by a transformation of bases. The new notation yields a sequential order of physical equations which lead to a dimensional analysis based on appropriately selecte equation groups.

GRAVITATION . RELATIVITY

5

16563 INERTIA OF ENERGY.
E.Feenberg.

Amer. J. Phys., Vol. 28, No. 6, 565-6 (Sept., 1960).

It is questioned whether anything has been proved in the several derivations of the inertial property of energy given by Einstein (Annalen der Physik, Vol. 20, 627, 1905; Vol. 23, 371, 1907), including that one based on the postulate that the centre mass of an isolated closed system is not displaced by internal cesses. From a re-examination of the system (pictured as a s ing gallery) in which electromagnetic radiation emitted at one carries energy and momentum to the other, a complete proof is now submitted of the above postulate. H.H.Ho

5

16564 THE EQUATIONS OF MOTION OF A SPECIAL TW BODY PROBLEM. S.Hess and M.Tischer.

Ann. Phys. (Leipzig), Vol. 6, No. 1-2, 15-24 (1960). In German

The problem considered is that of the motion of a particle inside a rotating spherical shell, the equations being derived fr the approximate relativistic equations of motion for a system o particles by integration over the spherical shell. Thirring's (1 centrifugal and Coriolis terms are obtained, apart from numeri factors, but there are additional terms corresponding to an inte field. R.A.Ne

5

16565 GENERAL COVARIANCE AND CONSERVATION LA
P.Droz-Vincent.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3582-4 (May 30, 1960 In French.

The application of Noether's theorem in the covariant form tion of conservation laws is discussed. R.A.Ne

53

16566 GLOBAL PROPERTIES OF PERIODIC CLOSED SP TIMES. A.Avez.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3585-7 (May 30, 1960) In French.

The cosmological constant is shown to be positive in the ca a perfect fluid in the presence of an electromagnetic field; the exterior metric is locally Euclidean. R.A.Ne

5

16567 AN APPROACH TO A THEORY OF GRAVITATION.
P.Rastall.

Canad. J. Phys., Vol. 38, No. 8, 975-82 (Aug., 1960).

The form of the space—time metric in a scalar theory of gravitation follows from the assumption that the potential is ar rary to the extent of an additive constant. No field equations ar needed. Expressions are found for the gravitational red shift, t perihelion motion of a planet, and the bending of light by the su From the observed values of these quantities one can determine metric and the potential due to a gravitating mass.

53

16568 CONTRIBUTIONS TO THE STUDY OF THE GRAVIT TIONAL INTERACTION OF MATERIAL BODIES.
Z.Gábos.

Nuovo Cimento, Vol. 15, No. 3, 395-407 (Feb. 1, 1960). In Fren

It is shown that, to the second approximation for weak field the motion of a system of gravitating particles may be defined i terms of a Lagrange function which is the sum of the kinetic ter a term arising from the field and a term representing particle- interaction. The results are applied to the case of two rotating spheres with Roche density distributions. R.A.Ne

530.12

16569 AN EXTENSION OF THE NEWTONIAN LAW OF GRAVITATION. J.A.Bastin.

c. Cambridge Phil. Soc., Vol. 56, Pt 4, 401-9 (Oct., 1960).

An attempt is made to relate such diverse phenomena as
tic energy, rest mass energy, the size of the universe, the
ocity of propagation both of light and gravitation, and the recession
he galaxies. The correlation is made by considering an extension
he Newtonian gravitational law which covers a particular simple
e when the two attracting bodies are in relative motion. The
ension is treated as postulatory, although in the last section,
ng the idea of gravitational flux, the assumed gravitational law
hown to be the simplest of a number of possible extensions
he Newtonian law. A new approach to special relativity is
lied.

530.12

16570 ENERGY TRANSFER BY GRAVITATION IN NEWTONIAN THEORY. H.Bondi and W.H.McCrea.

c. Cambridge Phil. Soc., Vol. 56, Pt 4, 410-13 (Oct., 1960).

The problem is considered as to whether, in accordance with
tonian theory, energy can be transferred from one system to
ther across empty space by gravitational interaction alone.
iliar examples of apparent energy transfer by this means do not
e an unambiguous answer since they involve some net change of
vitational potential energy and this is not localized in the theory.
o examples are given here of systems in which the potential
rgy is the same at the beginning and end of an operation that
s produce a resultant energy transfer. The establishment of this
ult is significant as a preliminary to the discussion of energy
nsfer according to general relativity theory. A particular
stration is given of one of the examples that admits mathematical
atment.

530.12

16571 SOME REMARKS ON PRESSURE-FREE MATTER IN AN ASYMMETRIC GRAVITATION THEORY (FOLLOW- D.W.SCIAMA AND O.COSTA DE BEAUREGARD).

.Tonnelat and L.Bouche.

t. Acad. Sci. (Paris), Vol. 250, No. 26, 4289-91 (June 27, 1960).
French.

In the asymmetric gravitation theory of Sciama (Abstr. 4699 of
8), the energy tensor is taken as that for dust (and therefore
ametric). The paths of particles are geodesics of the derived
tric $h_{\mu\nu}$ (where $h^{\mu\nu}$ is the symmetric part of $g^{\mu\nu}$), but the equa-
n of continuity is changed. The connection of this with Costa de
uregard's hypothesis of a gravitational effect of spin is worked
, to a first order of approximation and agrees.

C.W.Kilmister

530.12

16572 MOTION OF A GYROSCOPE ACCORDING TO EINSTEIN'S THEORY OF GRAVITATION. L.I.Schiff.

oc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 6, 871-82 (June, 1960).

In a detailed derivation and discussion of results already
lished (Abstr. 6663 of 1960) formulae are established for the
ecession of the spin axis of a torque-free gyroscope in free-fall,
constrained in an earth bound laboratory. Such gyroscopes would
as clocks and provide tests of the general theory going beyond
principle of equivalence.

R.A.Newing

530.12

16573 OBSERVATION OF LENGTH BY A SINGLE OBSERVER. R.Weinstein.

er. J. Phys., Vol. 28, No. 7, 607-10 (Oct., 1960).

One problem arising in teaching special relativity is the con-
ion in many texts of the thought experiments, used in developing
theory, with other simple laboratory operations. As an example
e considers here the observation of length. The existence of the
rentz—Fitzgerald contraction has led educators to conclude that
e sees a contraction of a rapidly moving body. However, the act
seeing involves a single observer, while the observation of the
rentz—Fitzgerald contraction requires at least two observers.
s shown here that the length seen by a single observer is not the
al contraction, and indeed, under certain circumstances, one sees
ody considerably lengthened rather than contracted.

530.12

16574 ON THE ORIGINS OF THE SPECIAL THEORY OF RELATIVITY. G.Holton.

er. J. Phys., Vol. 28, No. 7, 627-36 (Oct., 1960).

Einstein's early work on relativity theory is found to be related to his other work at that time (e.g. in subject matter and style). In addition to this element of internal continuity one finds also — as a key to a new evaluation of the significance of Einstein's contribution — an external continuity with the classic, Newtonian tradition governing restrictions on permissible hypotheses. On the other hand, Einstein's work is shown to have been, in important respects, more independent of other contemporary work in this field than has recently been proposed. These continuities and discontinuities are set forth to make the point that philosophical studies of scientific work should proceed on historically valid ground. Some guiding principles are indicated for dealing with conflicting source materials for such studies.

530.12

16575 ON THE PHYSICAL MEANING OF THE SPECIAL THEORY OF RELATIVITY. A.Datzeff.

Cahiers de Phys., Vol. 14, 99-108 (March, 1960). In French.

See Abstr. 9510 of 1957; 28 of 1958.

530.12

16576 REMARKS ON THE PAPER BY K.STIEGLER: "ON THE MECHANICAL FOUNDATION OF THE THEORY OF SPECIAL RELATIVITY". Z.Janković.

Nuovo Cimento, Vol. 16, No. 3, 569 (May 1, 1960).

The author claims that Stiegler's results (Abstr. 12981 of 1959) were partly anticipated in his thesis. See also following abstract.

C.W.Kilmister

530.12

16577 REPLY TO THE REMARKS OF Z.JANKOVIC ON MY PAPER: "ON THE MECHANICAL FOUNDATION OF THE THEORY OF SPECIAL RELATIVITY". K.Stiegler.

Nuovo Cimento, Vol. 16, No. 3, 579-81 (May 1, 1960). In German.

The author shows that Janković is mistaken, because the axioms of the original paper (Abstr. 12981 of 1959) differ from those of Janković.

C.W.Kilmister

530.12

16578 LIE RELATIONS ASSOCIATED WITH RELATIVISTIC ROTATORS AND BILOCAL THEORY.

F.Halbwachs and J.P.Vigier.

Nuovo Cimento, Vol. 16, No. 3, 576-8 (May 1, 1960).

It is shown that the linear momentum and total (spin + orbital) angular momentum, relative to the centre of matter density, for a relativistic rotating fluid droplet (Abstr. 12355 of 1960) are such that their Poisson brackets (in the classical sense) satisfy the Lie commutation formulae for the inhomogeneous Lorentz group, the commutators being replaced by Poisson brackets. This confirms the results of the usual correspondence principle.

C.W.Kilmister

530.12

16579 HYPERBOLIC MOTION IN CURVED SPACE TIME. W.Rindler.

Phys. Rev., Vol. 119, No. 6, 2082-9 (Sept. 15, 1960).

The differential equations of motion for a test particle moving with uniform acceleration in a curved space time are proposed. They are obtained by generalizing the differential-geometric characteristics of a rectangular hyperbola in Minkowski space time. The problem is proposed, though not solved, of deriving these equations of motion from the field equations of general relativity. However, it is suggested that they also hold independently of general relativity in cosmological space times based on the Robertson—Walker metric. The equations are solved in detail for the particular case of de Sitter space time, which is relevant to the steady-state theory. It is found, inter alia, that in this space time a particle moving radially with uniform acceleration ultimately moves with constant relative velocity through the substratum; that there is a critical first fundamental particle (galaxy) on its line of motion which it will never overtake; that, in turn, a light signal emitted at or after a certain critical time will not catch up with the accelerating particle; and that, if a particle with a given available acceleration α passes beyond a certain proper distance (the α horizon) it can no longer return to its place of origin. Possible applications to intergalactic rocketry are examined.

530.12

16580 NOTE ON THE SEPARATION OF RELATIVISTICALLY MOVING ROCKETS. A.A.Evett and R.K.Wangsness.

Amer. J. Phys., Vol. 28, No. 6, 566 (Sept., 1960).

It is pointed out that an incorrect conclusion is reached in a recent article by Dewan and Beran (Abstr. 12986 of 1959), viz. the separation between the tail of the first rocket and the head of the second remains constant. In fact, the distance between corresponding points of the two rockets will remain constant. A.Boksenberg

530.12

16581 A FARSIDE-TYPE ROCKET EXPERIMENT FOR THE MEASUREMENT OF THE GRAVITATIONAL TIME EFFECT. F.W.Lipps.

J. geophys. Res., Vol. 65, No. 2, 786-7 (Feb., 1960).

It is suggested that the gravitational time shift could be measured with some economy of rocket energy by comparing an earth clock with one mounted in a vertically fired rocket rather than in an earth satellite. A graph gives the Doppler and gravitational shifts for various maximum heights in the case of vertical firing from the equator. R.A.Newing

530.12

16582 NON-LINEAR LAGRANGIANS AND PALATINI'S DEVICE. H.A.Buchdahl.

Proc. Cambridge Phil. Soc., Vol. 56, Pt 4, 396-400 (Oct., 1960).

Field equations in general relativity theory have sometimes been generated by subjecting, in an invariant action integral, the components of linear connection and the components of a covariant tensor of valence 2 to independent variation. The conceptual objections to this process, and some of the manifold formal difficulties inherent in it, are discussed in some detail. At the same time certain results obtained elsewhere are strengthened and in part corrected.

530.12

16583 ELECTROMAGNETIC INDUCTION IN GENERAL RELATIVITY. C.Latrémolière.

C.R. Acad. Sci. (Paris), Vol. 25, No. 25, 4114-16 (June 20, 1960). In French.

The most general linear constitutive relations for electromagnetic theory in a curved space are written down and expressed in terms of electric and magnetic quantities for an arbitrary observer. Wave propagation is discussed and it is shown that in general, for a given wave-front in space, there are two wave-velocities in each direction C.W.Kilmister

530.12

16584 REPRESENTATION OF A WEAK RADIATION FIELD IN GENERAL RELATIVITY AND IN THE EINSTEIN—SCHRÖDINGER THEORY. A.Papapetrou.

C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 49-50 (July 4, 1960). In French.

Isothermal coordinates are used to find the first-order approximation (working in terms of the contravariant tensor density). The surprising result is that, at least in the first-order approximation, the gravitational radiation field has the same degree of independence as the electromagnetic. Thus the total number of polarization states in the Einstein—Maxwell theory is 2 + 2 = 4; the paper shows, however, that in the Einstein—Schrödinger unified theory this number is 5. C.W.Kilmister

530.12

16585 THE ASYMPTOTIC BEHAVIOUR OF A CLASS OF METRICS OF TYPE II. Le-Thanh-Phong.

C.R.Acad. Sci. (Paris), Vol. 251, No. 2, 210-12 (July 11, 1960). In French.

Results known for metrics of Petrov type III are generalized to type II. The Robinson equation

$$2\, l^{\alpha;\beta}\, l_{(\alpha;\beta)} = (l^{\alpha}{}_{;\alpha})^2$$

for the field then follows in this case too. Some additional assumptions are used to prove that the curvature tensor decomposes into parts IIIb, IIIa and II, of orders r^{-1}, r^{-2}, r^{-3} at infinity.

C.W.Kilmister

530.12

16586 CONSISTENCY OF THE CANONICAL REDUCTION OF GENERAL RELATIVITY.

R.Arnowitt, S.Deser and C.W.Misner.

J. math. Phys. (New York), Vol. 1, No. 5, 434-9 (Sept.-Oct., 1960).

The question of consistency of the canonical reduction of general relativity (obtained by eliminating constraints and also imposing coordinate conditions in the action or generator) is examined. It is shown that the equations of motion obtained from this "reduced" formalism agree with the original Einstein equations. Agreement is also established for the generators of space-time translations. In order to establish consistency, it is necessary discard certain well defined divergence terms in the original Lagrangian. These would otherwise appear as nondivergences i the reduced Lagrangian, incorrectly altering the equations.

5:

16587 ANALYSIS OF [RECTILINEAR] ACCELERATED MC IN THE THEORY OF RELATIVITY. R.T.Jones.

Nature (London), Vol. 186, 790 (June 4, 1960).

See Abstr. 866 of 1960.

5:

16588 MAXIMAL EXTENSION OF SCHWARZSCHILD MET. M.D.Kruskal.

Phys.Rev., Vol. 119, No. 5, 1743-5 (Sept. 1, 1960).

A particularly simple transformation of the Schwarzschild metric into new coordinates is presented, whereby the "spheric singularity" is removed and the maximal singularity-free exten is clearly exhibited.

5:

16589 THE MASS OF A STATIC CHARGED SPHERE. W.B.Bonnor.

Z. Phys., Vol. 160, No. 1, 59-65 (1960) .

The field of a static, charged sphere is investigated using general relativity. In Nordström's exterior solution the parame m and e, referring to mass and charge, are unrelated, and inde m can be put equal to zero. It is shown that, if the interior solu tion is considered, m cannot be put zero unless the matter densi is negative. The contribution of the electric field energy to the gravitational mass is estimated using certain special models. A model is given in which the gravitational attraction of the charge matter balances its electrical repulsion. If the radius is allowe to tend to zero, this gives a model of a point charge with finite a non-zero mass and charge.

530.12 : 5

16590 EQUIVALENCE PRINCIPLE "PARADOX" IN THE MOTION OF A GYROSCOPE. L.I.Schiff.

Nuovo Cimento, Vol. 17, No. 1, 124-5 (July 1, 1960).

The note describes an apparent violation of the equivalence principle in connection with the precession of the spin axis of a gyroscope moving in a uniform gravitational field. The paradox resolved by a realistic specification of the meaning of the term "uniform". H.Morri

53

16591 ON THE CONSERVATION IDENTITIES OF [TONNEL GENERALIZATION OF THE ASYMMETRIC UNIFIE FIELD THEORY. Nguyen Phong Chau.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3579-81 (May 30, 1960 In French.

530

16592 CONSERVATION IDENTITIES IN AN EINSTEIN—SCHRÖDINGER TYPE THEORY. L.Bouche.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3784-5 (June 8, 1960). In French.

The conservation identities are derived from generalized Bi identities in the case of a connection of zero torsion. R.A.New

530

16593 APPROXIMATION TO A GENERALIZATION OF THE EINSTEIN—SCHRODINGER THEORY.

Nguyen Phong Chau.

C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 44-6 (July 4, 1960). In French.

Field equations are calculated from a Lagrangian density $K_{\mu\nu}\mathcal{G}^{\mu\nu}$, where $K_{\mu\nu}$ is a linear combination both of the contracte curvature tensors of an affine connection $L^{\mu}_{\nu\sigma}$ with $L_{\nu} = 0$, and of the curl of a vector Γ_{μ} and of $\Gamma_{\mu}\Gamma_{\nu}$. The linear combination cho can be restricted by the requirement that, to the second order of approximation, the skew part of the metric tensor (regarded as small) should satisfy Maxwell's equations. C.W.Kilmis

530

16594 THE CURRENT THEOREM IN THE EINSTEIN—SCHRODINGER THEORY. Huyen-Dang-Vu.

C.R Acad. Sci. (Paris), Vol. 251, No. 1, 47-8 (July 4, 1960). In French.

The energy—momentum tensor in the Einstein—Schrödinger

ory is expressed in terms of a superpotential which is then re- ced (by analogy with a corresponding situation in general relativ- by a pseudo-tensor. This gives an energy—momentum pseudo- sor in terms of which Poynting's theorem can be deduced.
C.W.Kilmister

530.12

16595 THE PROJECTIVE INVARIANCE OF A GENERALIZATION OF THE NON-SYMMETRIC UNIFIED FIELD EORY. Nguyen Phong Chau.

Acad. Sci. (Paris), Vol. 251, No. 2, 207-9 (July 11, 1960). French.

The addition of $\delta^{\rho}_{\alpha} A_{\beta}$ or $\delta^{\rho}_{\beta} A_{\alpha}$ to a non-symmetric connection $_{\beta}$ is well known not to change parallel displacement (suitably ined). Such an addition is called a projective transformation. The terion of invariance under a projective transformation is used to it the generality of a unified theory whose Lagrangian is a linear nbination of contracted curvature tensors, and their transposes, the given connection and its transpose.
C.W.Kilmister

530.12

16596 QUADRATIC LAGRANGIANS AND GAUGE-INVARIANCE IN COVARIANT FIELD THEORIES. G.Stephenson.

oc. Cambridge Phil. Soc., Vol. 56, Pt 3, 247-51 (July, 1960).

Field equations are calculated for the three gauge-invariant adratic Lagrangian densities $R^2\Delta$, $R_{ik}R^{ik}\Delta$ and $R^{i}{}_{kmn}R_{i}{}^{kmn}\Delta$, ere $R^{i}{}_{kmn}$ is the curvature tensor of a non-symmetric connection, d $-\Delta^2$ the determinant of a non-symmetric second-rank tensor, $= g^{ij}R_{ij}$ as usual). Only the first one is found to give results ear in the R_{ik}, as in the Einstein—Schrödinger theory.
C.W.Kilmister

QUANTUM THEORY

(Applications of quantum theory to elementary particles and nuclei are included under Nuclear Field Theory)

530.14

16597 THE INTERPRETATION OF WAVE MECHANICS. L.de Broglie.

Phys. Radium, Vol. 20, No. 12, 963-79 (Dec., 1959). In French.

A restatement using the double-solution theory. Some recent sults are reviewed.

530.14

16598 AN IMPROVED VERSION OF AN ERGODIC THEOREM IN QUANTUM MECHANICS. G.M.Prosperi and A.Scotti.

ovo Cimento, Vol. 17, No. 2, 267-8 (July 16, 1960).

This provides a stronger version of a theorem established in an rlier paper (Abstr. 13027 of 1959).
H.Morrison

530.14

16599 ON THE UNCERTAINTY PRINCIPLE. S.W.Matthysse.

mer. J. Phys., Vol. 28, No. 6, 560-1 (Sept., 1960).

It is impossible to confine a particle both in position and omentum. A proof and some applications of this theorem are iven.
H.Morrison

530.14

16600 THE BASIC EQUATIONS OF NON-RELATIVISTIC WAVE MECHANICS. A.Rot.

nn. Inst. Poincare, Vol. 16, No. 4, 235-87 (1960). In French.

A fundamental study of the relationships between the fields of lassical dynamics, the calculus of variations, optics and wave echanics, carries forward some of the ideas of de Broglie on ouble solutions and singularities in wave-functions (see Abstr. 483 of 1953; 96 of 1954; 74, 1550, 2437, 9441 of 1955). A generalized time-dependent wave-equation is derived from Hamilton's rinciple, in a five-dimensional space.
J.Hawgood

530.14

16601 A POSSIBLE NON-UNIFORM MOTION OF A FREE PARTICLE IF ITS SCALAR PROPER FIELD IS TAKEN NTO ACCOUNT. I.Abonyi.

uovo Cimento, Vol. 15, No. 6, 991-2 (March 16, 1960).

It is suggested that the classical relativistic equation of motion as runaway self-accelerating solutions which are, at the same time, scillatory.
E.J.Squires

530.14

16602 NON-LINEAR OSCILLATIONS IN WEAK EXTERNAL FIELDS, DESCRIBED BY LAGRANGE'S EQUATIONS.

V.I.Gaiduk.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 760-3 (Aug. 1, 1960). In Russian.

On transforming canonically the position and the momentum coordinates (so that the form of Hamiltonian is conserved), one obtains exact equations for chosen parameters of an oscillatory motion (e.g. amplitude, phase, etc.). The method is exemplified by a one-dimensional periodic and an almost periodic motion; it yields equations suitable for asymptotic expansion.
J.K.Skwirzynski

530.14

16603 SEPARATION THEOREM FOR DEGENERATE EIGENVALUES. D.W.Davies.

J. chem. Phys., Vol. 33, No. 3, 781-3 (Sept., 1960).

An algebraic theorem concerning the separation of the eigenvalues of a matrix is discussed for degenerate eigenvalues in variation calculations. It is shown that the occurrence of degenerate eigenvalues in a given approximation does not prevent the application of the theorem to the determination of upper bounds for exact eigenvalues in physical problems.

530.14

16604 DESCRIPTION OF THE EXTENDED TUBE. A Grossmann.

J. math. Phys. (New York), Vol. 1, No. 2, 85-6 (March-April, 1960).

Necessary and sufficient conditions are given for the belonging of an n-tuple of complex four-vectors to the extended tube.

530.14

16605 RIGOROUS DERIVATION OF THE PHASE SHIFT FORMULA FOR THE HILBERT SPACE SCATTERING OPERATOR OF A SINGLE PARTICLE. T.A.Green and O.E.Lanford, III.

J. math. Phys. (New York), Vol. 1, No. 2, 139-48 (March-April, 1960).

For a single nonrelativistic particle moving in a spherically symmetric potential, the existence of the Hilbert space wave operators and S operator is proved and phase shift formulae for these operators are deduced. The probability, $P(\Omega)$, for scattering into the solid angle Ω is obtained from the time dependent theory. The relation between $P(\Omega)$ and the R matrix of the standard plane wave formulation of scattering theory is established. For collimated incoming packets, it is shown that $P(\Omega)$ can be expressed as an energy average of the differential cross section.

530.14

16606 ANALYTICITY OF THE FOURTH ORDER SCATTERING AMPLITUDE WITH TWO COMPLEX INVARIANTS.

J.Tarski.

J. math. Phys. (New York), Vol. 1, No. 2, 149-64 (March-April, 1960).

The partial Feynman amplitude corresponding to a particular fourth order diagram is examined as a function of energy and momentum transfer with both of these variables complex. The region of regularity of this function is found, and the types of singularities at the remaining points are determined. An approach which requires only elementary calculations is indicated. The condition for the validity of Mandelstam's representation in the fourth order is obtained. Spectral representations for exchange scattering processes at fixed momentum transfer are discussed as another application of the principal results.

530.14

16607 ON THE MANY-PARTICLE STRUCTURE OF GREEN'S FUNCTIONS IN QUANTUM FIELD THEORY.

K.Symanzik.

J. math. Phys. (New York), Vol. 1, No. 4, 249-73 (July-Aug., 1960).

The structure of the expectation values of retarded multiple commutators (r functions) is analysed in terms of the number of particles in the decomposition of absorptive parts. As to the one-particle structure, it is found that an r function is a sum of a finite number of terms, each of them except one (that one being called one-particle irreducible) being in momentum space a product of one-particle irreducible factors, linked by one-particle propagation functions. As to the two-particle structure, it is found that a one-particle irreducible function is the solution of an inhomogeneous Bethe—Salpeter equation, whose kernel and inhomogeneous term are both two-particle irreducible functions. This structure, which could be generalized to higher particle numbers, closely resembles perturbation theory but is here derived from locality and the asymptotic condition alone, by converting the nonlinear system of integral equations for r functions stepwise into one in which neither one- or two-particle reducible functions, nor one- or two-particle intermediate states appear. The implication of such structure analysis for an interpretation of perturbation theory, improvements of present methods to derive analytic properties of scattering amplitudes, and a formalism with unstable particles are discussed, and the strength of singularities of various functions investigated.

530.14

16608 NORMAL FORM OF ANTIUNITARY OPERATORS. E.P.Wigner.

J. math. Phys. (New York), Vol. 1, No. 5, 409-13 (Sept.-Oct., 1960).

Antiunitary operators are characterized in a manner similar to the characterization of unitary operators by their characteristic vectors and characteristic values. It is shown that a complete orthonormal set of vectors can be defined, some of which are invariant under the antiunitary operator. The rest of the vectors, which are always even in number, form pairs in such a way that the antiunitary operator transforms each member of a pair into a multiple of the other member of the same pair. The extent to which the vectors of the orthonormal set are determined by the antiunitary operator is ascertained and the number of free parameters in the various cases of degeneracy found.

530.14

16609 PHENOMENOLOGICAL DISTINCTION BETWEEN UNITARY AND ANTIUNITARY SYMMETRY OPERATORS

E.P.Wigner.

J. math. Phys. (New York), Vol. 1, No. 5, 414-16 (Sept.-Oct., 1960).

It is well known that one always can find as many orthogonal states (i.e., states between which the transition probability is zero) as the Hilbert space has dimensions which are invariant under a given unitary transformation. The corresponding vectors are characteristic vectors of the unitary operator. In contrast, most antiunitary operators leave not more than one state invariant. However, if there are two orthogonal invariant states, a consideration of the states for which the transition probability is $\frac{1}{2}$ into both invariant states surely provides a distinction. In the antiunitary case, one of these states is also invariant, another one is transformed into an orthogonal state, the rest are in between. In the unitary case, the transition probability between original state and transformed state is the same for all states for which the transition probability is $\frac{1}{2}$ into two orthogonal states. This provides a "directly observable" distinction between unitary and antiunitary transformations.

530.14

16610 REAL REPRESENTATIONS OF COORDINATE ROTATIONS. U.Fano.

J. math. Phys. (New York), Vol. 1, No. 5, 417-23 (Sept.-Oct., 1960).

Since irreducible tensorial sets that represent observables are of integral degree, their transformations under coordinate rotations have real representations. Real representations, with rows and columns classified by eigenvalues of the commuting operators J_z^2 and $\exp(i\pi J_y)$, are given explicitly, so that complex functions of rotation angles need not be used. The addition of angular momenta is worked out for sets in the real representation such as the sets of real orbital wave functions. Applications to the theory of angular distributions are discussed.

530.14

16611 ON THE ANISOTROPY OF INERTIA. S.T.Epstein.

Nuovo Cimento, Vol. 16, No. 3, 587-8 (May 1, 1960).

Previous considerations of the subject which have placed an upper limit on the possible anisotropy of inertia, have assumed that only the kinetic energy terms of the Hamiltonian are anisotropic. It is suggested that the potential energy terms may also be anisotropic, and that the assumptions made regarding these terms can greatly affect any predictions. A simple example is given in which both kinetic and potential energy terms are separately anisotropic while the complete Hamiltonian is isotropic. H.Morrison

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STATISTICAL MECHANICS
TRANSFER PROCESSES

53

16612 ANALYTICAL INVARIANTS IN N-BODY SYSTEMS. P.Résibois and I.Prigogine.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 2, 53-60 (1960).

The existence of a new class of invariants analytic in the coupling constant for systems of interacting particles is indicat These invariants have singular Fourier transforms so that the classical theorem of Poincaré does not apply. J.Golds

53

16613 OPEN FIRST-ORDER STOCHASTIC PROCESSES. P.J.Gans.

J. chem. Phys., Vol. 33, No. 3, 691-4 (Sept., 1960).

The solution of the general open first-order stochastic proc representing the relaxation of an open multistate system is obtai by the generalization of a method of Krieger and Gans. The resu is valid for a system containing an arbitrary number of absorbin and semiabsorbing states as well as allowing the presence of an number of emitting states. The stability of the solution is discus in terms of the matrix of the transition probabilities. This is d with the aid of a theorem of Lévy and Hadamard. The result is applied to the corresponding closed system as well as the presen work.

530

16614 VARIATIONAL METHOD FOR STUDYING THE MOTION OF CLASSICAL VIBRATING SYSTEMS.

J.M.Luttinger and R.B.Thomas, Jr.

J. math. Phys. (New York), Vol. 1, No. 2, 121-6 (March-April, 1

A quantity Z (essentially the action integral) is shown to be stationary for small periodic deviations from the actual motion. By choosing approximations to the motion containing the frequen and some other parameters, it is possible to make this variation principle the basis of an approximate determination of the motio Quite simple trial functions are found to give surprisingly accur values for the frequency and the Fourier components of the moti Comparison between the exact solution and ours for some system is given.

53

16615 NEW THEOREM IN THE CLASSICAL ENSEMBLE THEORY. S.Albertoni, P.Bocchieri and A.Loinger.

J. math. Phys. (New York), Vol. 1, No. 3, 244-8 (May-June, 1960)

In the framework of the classical ensemble theory a theore is proved which is sufficient to justify the classical statistical mechanics. The result can be stated as follows. Consider a fixe and otherwise arbitrary subdivision in cells I_ν ($\nu = 1, 2, \cdots, N$) o the energy shell I of an isolated dynamical system: Having introduced a suitable definition of functional average it is proved that for "almost all" the initial Liouville density functions $\rho(p',q';0)$

$$\lim_{T\to\infty}\frac{1}{T}\int_0^T dt \left\{\left[\int_{I_\nu}\rho(p'q';t)dp'dq' - \frac{\sigma_\nu}{\sigma}\right]^2\right\} = 0,$$

where σ_ν and σ are the measures of I_ν and I, respectively. The unitarity of the Koopman—von Neumann time-evolution operator is the dynamical property needed to establish this theorem. On t basis of this result, it can be shown that systems with very many degrees of freedom satisfy the laws of statistical mechanics.

530

16616 INVARIANT IMBEDDING AND MATHEMATICAL PHYSICS. I. PARTICLE PROCESSES.

R.Bellman, R.Kalaba and G.M.Wing.

J. math. Phys. (New York), Vol. 1, No. 4, 280-308 (July-Aug., 196

Using invariance principles in a systematic fashion, new analytic formulations of the classical particle processes: transp theory, radiative transfer, random walk, multiple scattering, and diffusion theory are derived, and, in addition, new computational algorithms which seem well fitted to the capabilities of digital computers. Whereas the usual methods reduce problems to the solution of systems of linear equations, here the problems are reduced to the iteration of nonlinear transformations.

530.16

6617 THE SOLUTION OF THE STEADY STATE DISTRIBUTION IN NON-EQUILIBRIUM PROCESSES.

.E.Meijer and J.I.Bowen.

sica, Vol. 26, No. 7, 478-84 (July, 1960).

The master equation, written in continuous form, is solved with mplete set of functions. The condition of detailed balancing is d to symmetrize the integral equation. The functions are chosen e orthogonal to the equilibrium solution and the components are gested to be useful as non-equilibrium (steady state) parameters. general solution for the steady state of two thermally coupled tems is evaluated.

530.16

16618 ON THE GENERAL THEORY OF THE APPROACH TO EQUILIBRIUM. I: INTERACTING NORMAL MODES.

rigogine and F.Henin.

math. Phys. (New York), Vol. 1, No. 5, 349-71 (Sept.-Oct., 1960).

A general method which permits the derivation of the equations ich describe the approach to equilibrium correct to an arbitrary ite order in the coupling constant is presented. This method applied to normal modes interacting through three-phonon cesses. The distribution function is first Fourier-analysed h respect to the angle variables. All Fourier components, cept the distribution function of action variables, describe relations among the normal modes. The formal solution the Fourier components is studied in the limiting case of a very ge number of degrees of freedom N → ∞, and for large times by ans of a diagram technique. Each component ρ_{3n} can be split into parts: ρ_{3n}' and ρ_{3n}''; one (ρ_{3n}') due to "scattering" of the normal des satisfies diagonal differential equations. The other (ρ_{3n}'') ntains the direct interaction between the normal modes involved the corresponding correlation. It is completely determined by the ctions ρ_{3n}'. The study of this set of equations enables the approach equilibrium to be studied.

530.16

16619 LIOUVILLE EQUATION AND THE RESOLVENT FORMALISM. S.Teitler and R.F.Wallis.

math. Phys. (New York), Vol. 1, No. 5, 372-7 (Sept.-Oct., 1960).

With the use of the Prigogine and Balescu representation ostr. 10614-15 of 1960) for the description of relaxation starting m the Liouville equation, Van Hove's resolvent formalism is plied to obtain higher-order contributions for classical weakly ipled homogeneous gases. These results confirm Van Hove's servation that, for appropriate representations, persistent (long ne) effects are determined by diagonal matrix elements of operas consisting of products of perturbative operators separated by gonal operators. The mechanism of relaxation is also discussed. r Van Hove's papers see Abstr. 7706 of 1955; 2689, 4847 of 1956; 40 of 1957.

530.16

16620 FORMAL SOLUTION OF LIOUVILLE'S EQUATION. O.von Roos.

math. Phys. (New York), Vol. 1, No. 2, 107-11 (March-April, 1960).

A formal solution of Liouville's equation both for the classical d for the quantum mechanical case is presented. The derivation lows closely the approach employed by Feynman in his papers the theory of positrons (see Abstr. 243, 2187 of 1950). A attering operator S is found which connects the distribution ction at time t' with the distribution function at any later time t. ch term of this scattering operator can be represented uniquely d conveniently by a diagram. The topological structure of these grams is the same in the classical as well as in the quantum chanical case. For applications of the method see following stract.

530.16 : 537.56

16621 SOLUTION OF THE COLLISIONLESS BOLTZMANN EQUATION USING A DIAGRAM TECHNIQUE.

von Roos.

math. Phys. (New York), Vol. 1, No. 2, 112-20 (March-April, 1960).

The diagram technique recently developed by the author receding abstract) for the solution of Liouville's equation is tended and suitably modified to cover the case of the collisionless oltzmann equation for a plasma. The usefulness of the method is monstrated by two problems. These are: first, the influence of a ane polarized electric wave on the electron distribution function a low-temperature plasma, and second, the propagation of a mall) initial disturbance for the case of a plasma which is verned by the Vlasov equation.

530.16

16622 DIFFERENTIAL-OPERATOR APPROXIMATIONS TO THE LINEAR BOLTZMANN EQUATION. A.Siegel.

J. math. Phys. (New York), Vol. 1, No. 5, 378-90 (Sept.-Oct., 1960).

A measure of deviation from equilibrium of an ensemble of particles is proposed, which is physically appropriate and of especially simple form when expressed in terms of the expansion coefficients of the ensemble distribution function with respect to the system of orthogonal polynomials obtained by using the equilibrium distribution function as weight function. The linear Boltzmann operator can then be expanded in a series of terms which, under certain circumstances, may be regarded as of successively diminishing magnitude in their effect on the rate of approach to equilibrium. This expansion of the operator is different from the expansion due to Kramers (later discussed by Moyal) in derivate moments, commonly used in approximate stochastic treatments of irreversible processes. With the aid of a theorem on definite operators, it is possible to break off the series at any point and thereby obtain a correspondingly accurate approximation to the linear Boltzmann operator, whose temporal solutions tend to the correct equilibrium distribution function. The first approximation is the Fokker—Planck operator, exactly. The next approximation would be the appropriate operator to use when the stochastic variable begins to deviate appreciably from a linear dissipation law, etc. The method is applied to the "Rayleigh process" (ensemble of particles in a rarefied gas medium, the medium itself being in internal equilibrium), and the second approximation to the linear Boltzmann operator for this case is explicitly derived. A possible form for the second approximation in more general processes, suggested by this, is also given.

530.16

16623 TOPOLOGICAL DERIVATION OF THE MAYER DENSITY SERIES FOR THE PRESSURE OF AN IMPERFECT GAS. M.S.Green.

J. math. Phys. (New York), Vol. 1, No. 5, 391-4 (Sept.-Oct., 1960).

A new derivation of Mayer's classical density expansion for the pressure of an imperfect gas based on a classification of cluster graphs according to topological criteria is presented. The classification is a generalization of the classification of simple trees into trees with centres and trees with bicentres.

530.16

16624 GROUND AND EXCITED STATES OF A MANY-BODY SYSTEM WITH SINGULAR INTERACTION. K.Sawada.

Phys. Rev., Vol. 119, No. 6, 2090-7 (Sept. 15, 1960).

The procedure to get the ground-state energy and excitation spectrum by looking at the normal modes for the simple excitations of a many-body system is extended and applied to a system with singular interaction. It is shown that the singular two-body interaction can be consistently replaced by the so-called reaction matrix in the equations of motion and in the expressions for the energies of ground and excited states.

530.16

16625 TEMPORAL FLUCTUATIONS IN A CLASSICAL LINEAR SYSTEM. R.E.Turner.

Physica, Vol. 26, No. 4, 274-83 (April, 1960).

The time-dependent fluctuations in a system of N classical particles interacting with linear forces is investigated by the use of the theory of random time series given by Ming Chen Wang and Uhlenbeck (Abstr. 1512 of 1946). It is found that under certain assumptions the return to equilibrium may be interpreted as irreversible. The implications of these assumptions are discussed.

530.16

16626 MOTION OF A HEAVY PARTICLE IN A ONE DIMENSIONAL CHAIN. R.E.Turner.

Physica, Vol. 26, No. 4, 269-73 (April, 1960).

The velocity auto-correlation function of a heavy particle substituted in a some dimensional lattice of identical particles is calculated. The behaviour of this function is such that the particle obeys, over a restricted time range, a Langevin equation for a harmonically bound particle.

530.16

16627 PAIR DISTRIBUTION FUNCTION OF A HARD SPHERE BOSE SYSTEM CALCULATED BY THE PSEUDO-POTENTIAL METHOD. L.S.Garcia-Colin.

J. math. Phys. (New York), Vol. 1, No. 2, 87-96 (March-April, 1960).

The pair distribution function for a hard sphere Bose system has been calculated by using a method in which the hard sphere potential is replaced by the so-called pseudo-potential. The problem is carried through using the quasi-particle formalism of Bogoliubov. In this calculation one considers a system of bosons interacting via the pseudo-potential which can be regarded as a weak interaction when the system is very dilute. The Hamiltonian of the system is diagonalized by means of a canonical transformation which has the effect of separating the energy into two parts, one of which is the ground state energy and the other corresponds to an ideal Bose gas composed of "elementary excitations" or "quasi-particles". This formalism is applied to the calculation of the pair distribution function. This quantity is calculated by averaging over a grand canonical ensemble constructed with the total number of elementary excitations. A result which is seen to be valid both for the condensed and gaseous phases of the system and also for any distance r between the particles is obtained. A discussion of the difference between these results and the ones obtained in a previous calculation and a comparison between both results and the experimental ones is also given.

530.16

16628 ON THE PAIR DISTRIBUTION FUNCTION OF A HARD SPHERE BOSE SYSTEM.

L.S.Garcia-Colin and J.Peretti.

J. math. Phys. (New York), Vol. 1, No. 2, 97-106 (March-April, 1960).

The pair distribution function for a quantum Bose gas is expresexpressed as a power series in terms of the fugacity, the coefficients of which are temperature dependent. For the hard sphere case, these coefficients have been evaluated to the first order in a/λ (a being the scattering length and λ the thermal wavelength) by using torons with two fixed points, or alternatively U cluster functions. The result gives the first order correction to the ideal gas formula of London and Placzek introduced by the interactions between the particles.

530.16

16629 HARD SPHERE BOSE GAS: AN EXACT MOMENTUM SPACE FORMULATION.

E.Lieb.

Proc. Nat. Acad. Sci. U.S.A., Vol. 46, No. 7, 1000-2 (July, 1960).

The exact Hamiltonian for the second-quantized momentum-space formulation of the problem is given as a limit, the limiting process consisting of the approach from outside to the forbidden region (where spheres overlap) of the 3N-dimensional space. It is suggested that no momentum-space Hamiltonian exists for the whole space. J.Hawgood

530.16

16630 EXPANSION FORMULAE OF THE FREE ENERGY AND DISTRIBUTION FUNCTIONS IN POWERS OF THE ONE PARTICLE DISTRIBUTION FUNCTION.

T.Morita.

Progr. theor. Phys , Vol. 21, No. 4, 501-10 (April, 1959).

A new method is proposed which enables one to convert the formulae for a uniform multi-component system to those for a non-uniform one. As an application of the method, the expansion formulae of the free energy, potentials of average force and distribution functions for a non-uniform multi-component system are derived in a simple and systematic way. The formulae are obtained both for a continuous and for a lattice system. The formula obtained for the free energy for a continuous system coincides with that given by Arinstein, and the first few terms of the formulae for the free energy and the pair distribution function for a lattice system are identical to those given by Yvon. A procedure to convert the formulae for a continuous system to those for a lattice system and vice versa is given.

530.16

16631 CONVERGENCE OF THE BORN EXPANSION.

R.Aaron and A.Klein.

J. math. Phys. (New York), Vol. 1, No. 2, 131-8 (March-April, 1960).

The convergence of the iterated Born series for the Green's function in nonrelativistic potential scattering is studied in n dimensions, thus generalizing a recent study of Zemach and Klein (see Abstr. 5369 of 1959). For spherically symmetrical potentials the series is proved to converge at sufficiently high energies for a rather general class of potentials.

530.16

16632 ON THE STATISTICAL INTERPRETATION OF THE PHENOMENOLOGICAL THEORY OF IRREVERSIBLE PROCESSES.

J.P.Guiraud.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 213-15 (July 11, 1960).
In French.

It is pointed out that the environment of a typical set of colliding molecules can safely be treated as macroscopically continuous, which suggests that there may be ways of avoiding the explicit use of Boltzmann's equation. It is claimed that the prop form of the dissipation function can be deduced from the sole postulate that entropy changes can be related to the changes in th distribution function due to collisions. Pursuit of this argument leads to expressions for thermal conductivity and viscosity of a practically equivalent to the first approximation of Chapman and Cowling. H.N.V.Tempe

53

16633 ON THE SOLUTION OF TRANSPORT EQUATION FO NEUTRON DIFFUSION IN THE MILNE—EDDINGTON MODEL.

S.R.Das Gupta.

Indian J. theor. Phys., Vol. 5, No. 2, 39-48 (June, 1957).

The simple transport equation is considered governing the passage of mono-energetic neutrons through a large slab of non-capturing medium having uniformly distributed neutron sources c constant strength. The neutrons are scattered anisotropically wi out change of energy. Apart from the current contributed by the neutron sources, a constant steady neutron current is otherwise maintained in the outward direction normal to the plane face of th slab. The emergent neutron distribution $I(O,\mu)$ is given in a clos form as an explicit function of μ (= cos θ) defined for the entire co plex μ-plane. When scattering is not highly anisotropic, if in the expansion of the scattering cross-section in spherical harmonics first two terms are retained it is seen that the neutrons after bei scattered anisotropically while diffusing through the non-capturin medium, show complete isotropy after emergence. If, however, i the above expansion the first three terms are retained, anisotrop arising out of the second term is absent in the emergent beam wh only shows non-isotropy to the extent measured by the third term When the effect of the third term is taken to be very small a simp closed form of $I(O,\mu)$ may be obtained.

530

16634 ON THE EXACT SOLUTION OF TRANSFER EQUATI IN THE MILNE-EDDINGTON MODEL: SCATTERING ACCORDING TO RAYLEIGH PHASE FUNCTION.

S.R.Das Gupta

Indian J. theor. Phys., Vol. 6, No. 3, 77-84 (Sept., 1958).

The transfer equation for the conservative case of grey scatt ing according to Rayleigh phase function is exactly solved by Wiener—Hopf technique. The law of darkening H(z) is obtained in a closed form, as an explicit function of z, defined for the entire complex z-plane. The asymptotic form of the average intensity comes out as a linear function of the optical depth.

530.

16635 ON QUANTUM THEORY OF TRANSPORT PHENOME

S.Nakajima.

Progr. theor. Phys., Vol. 21, No. 4, 659 (April, 1959).

Additional remarks are made to the discussion of the Einstei relation in Abstr. 14542 of 1960.

530.

16636 GIANT FLUCTUATIONS IN A DEGENERATE FERMI GAS.

W.Kohn and S.J.Nettel.

Phys. Rev. Letters, Vol. 5, No. 1, 8-9 (July 1, 1960).

It is shown that Overhauser's suggestion (Abstr. 11125, 13513 1960), that the ground state of a weakly-interacting fermion gas ha giant density fluctuations, does not apply except in the one-dimens case. J.Hawgo

530.16 : 536.

16637 TWO-BODY CORRELATION OF INTERACTING FERMIONS.

K.Nakamura.

Progr. theor. Phys., Vol. 21, No. 5, 713-26 (May, 1959).

The electron-pair model, proposed for superconductivity by Bardeen, Cooper and Schrieffer (Abstr. 6193 of 1957) is discussed in configuration space. The wave-function for the system of electron-pairs is taken as follows,

$$\Psi_0 = \sum_{P} (-1)^P P\{\chi(1,2)\,\chi(3,4)\cdots\cdots\chi(2N-1,2N)\},$$

where $\chi(1,2)$ is the wave-function for the singlet state of a two-electron system. By a method having a remarkable similarity to Mayer's theory of an imperfect gas, the expectation value of the system can be obtained rigorously. The expression for energy coincides with that which is given by Bogoljubov in his theory of superconductivity. By a variational method, Bogoljubov's integral equation is obtained.

530.16 : 537.2

16638 THE ELECTRIC AND MAGNETIC RESPONSE OF A THERMODYNAMIC SYSTEM.

I.Blatt and T.Matsubara.

ogr. theor. Phys., Vol. 21, No. 5, 696-712 (May, 1959).

When a system in thermal equilibrium is exposed to arbitrary weak electromagnetic fields, currents are induced by the fields, portional to the field strengths. The Kubo formalism allows a eral discussion of this "linear response", and the calculation has n carried out by Nakajima. However, the separation of the in- ed current into an "electric" and a "magnetization" current uires additional physical assumptions. This separation is carried here. The "electric" current is then further separated into phase and out-of-phase contributions. This yields an explicit mula for the complex dielectric constant as a function of the ve number and frequency of the impressed electric field. These mulae have the same generality as the formulae of equlibrium tistical mechanics.

530.16 : 539.2 : 538:27

16639 IRREVERSIBILITY IN INTERACTING SPIN SYSTEMS.

J.Philippot.

ys. Rev., Vol. 119, No. 6, 1803-7 (Sept. 15, 1960).

A system whose Hamiltonian is split into two terms $=\mathcal{H}_0 + \lambda V$ exhibits two types of irreversible processes. The st processes are described by $\mathcal{H}_0$ alone; only the second processes, ich result from the perturbation, lead to an increase of the entropy the system. These processes are illustrated by the examples of e precession and cross-relaxation. General formulae are given transition probabilities and the expressions, applied to cross- laxation in LiF, agree with the results obtained by Bloembergen d Pershan.

530.16

16640 THERMODYNAMICS OF IRREVERSIBLE PROCESSES.

Rendiconti della Scuola Internazionale di Fisica Enrico rmi, Corso X. Bologna: Zanichelli (1960) 317 pp.

The lectures given at the Varenna summer school from the th-17th June 1959 under the auspices of the Societè Italianca di sica, are written up in the form of thirteen continuous papers ome of which must correspond to more than one lecture). One of em deals with equilibrium thermodynamics, eleven with the neral theory of non-equilibrium systems and one with the more ecialized topic of the electrical properties of ice. They are mmarized in the following abstracts. H.N.V.Temperley

530.16 : 536.7

16641 THE LAWS OF THERMODYNAMICS.

M.J.Klein.

ermodynamics of irreversible processes, p.1-22.

Outlines the derivations of the second law according to Clausius d Carathéodory and solves some elementary problems by analytical ermodynamics. Simon's discussion of the third law is given, and relation with statistical mechanics is examined in an appendix.

H.N.V.Temperley

530.16

16642 THEORY OF FLUCTUATIONS.

A.Münster.

ermodynamics of irreversible processes, p. 23-130

Derives a very large number of results on fluctuations in dinary and nearly critical assemblies, also some results on rrelations and the scattering of X-rays and neutrons. Some eoretical work on correlation functions is outlined and compared th experiment, agreement being reasonable. 84 references.

H.N.V.Temperley

530.16

16643 NON-EQUILIBRIUM THERMODYNAMICS.

S.R.De Groot.

ermodynamics of irreversible processes, p. 131-61.

Discusses the equations of entropy balance and the Onsager lations. Appendices explain the Curie principle, which limits the ssible types of cross-effect between irreversible processes, and form taken by the Onsager relations for vectorial phenomena.

H.N.V.Temperley

530.16

16644 ONSAGER'S RELATIONS FOR VECTORIAL PHENOMENA. R.Fieschi.

ermodynamics of irreversible processes, p. 162-6.

Shows how Onsager's arguments, based on scalar processes, can adapted to vectorial and tensorial irreversible phenomena.

H.N.V.Temperley

530.16

16645 ON THE STATISTICAL BASIS OF NON-EQUILIBRIUM THERMODYNAMICS. P.Mazur.

Thermodynamics of irreversible processes, p. 167-97.

Non-equilibrium thermodynamics is approached by dividing up an assembly into small sub-assemblies. If the interactions between these are neglected, the results of random variable theory can be used to make predictions about the results of measurements on the whole assembly. Among topics discussed from this standpoint are the definition of intensive variables, microscopic reversibility, the H-theorem and non-equilibrium situations. H.V.N.Temperley

530.16

16646 THE PRINCIPLE OF MINIMUM ENTROPY PRODUCTION

M.J.Klein.

Thermodynamics of irreversible processes, p. 198-204.

Two idealized assemblies are studied, one consisting of two vessels of gas maintained at different temperatures and connected by a capillary, the other an assembly of systems (each having two states only) exposed to radiation and in contact with a heat bath. The statistical histories of such assemblies can be calculated explicitly, and the principle is shown to hold for small departures from equilibrium. H.N.V.Temperley

530.16

16647 STATISTICAL MECHANICS OF TRANSPORT PROCESSES.

J.G.Kirkwood.

Thermodynamics of irreversible processes, p. 205-16.

Expressions for viscosity and heat-conductivity are derived as time integrals over correlation functions. The time interval must be large compared with the time between collisions but must not be infinite. Assuming the existence of such a suitable time-scale, the integrals are expected to be very insensitive to the time-interval actually used. On this assumption, these integrals can safely be identified with the transport coefficients and a simple proof that the coefficients so defined obey the Onsager relations is given.

H.N.V.Temperley

530.16

16648 ON THE STATISTICAL MECHANICS OF TRANSPORT PROCESSES. E.W.Montroll.

Thermodynámics of irreversible processes, p. 217-61.

Defines Wiener integrals, Feynman integrals and Feynman diagrams, the latter being associated with the successive terms of perturbation expansions. The transport coefficients are evaluated as time averages (see preceding abstract) and the average over time is replaced by an ensemble average, which, in each case, is the trace of an appropriate operator. These can be evaluated by a diagram technique, and the contributions of some typical diagrams are studied. Some divergence difficulties in the calculation of transport processes are discussed. It is shown that, if the sum over all relevant diagrams actually converges, the answer is equivalent to the solution of a Boltzmann-type equation. 26 references.

H.N.V.Temperley

530.16 : 539.2

16649 IRREVERSIBLE PROCESSES IN SOLIDS.

F.Henin.

Thermodynamics of irreversible processes, p. 262-74.

The assembly considered is supposed to be reduced to simple harmonic oscillators with cubic perturbation terms. A diagram technique for solving the Liouville equation is introduced. The contributions from a particular type of diagram are shown to give rise to irreversibility. H.N.V.Temperley

530.16

16650 ON QUANTUM THEORY OF IRREVERSIBLE PROCESSES.

S.Nakajima.

Thermodynamics of irreversible processes, p. 275-81.

Kubo's expressions for transport coefficients are derived. It is claimed that the results of traditional kinetic theory are equivalent to the first terms of certain expansions of these expressions. A simple generalization of the work to the case of thermal driving forces is given. H.N.V.Temperley

530.16

16651 ON THE STATISTICAL MECHANICAL THEORY OF IRREVERSIBLE BEHAVIOUR. P.Mazur.

Thermodynamics of irreversible processes, p.282-93.

Derives some general results from known theorems on gaussian processes and then discusses the extent to which they are applicable to actual assemblies. It is concluded that this is not possible at present, but more general theorems are already known which, it is suggested, may be so applicable. H.N.V.Temperley

530.16 : 539.2 : 537.3

16652 THE ELECTRICAL PROPERTIES OF ICE. L.Onsager and M.Dupuis.
Thermodynamics of irreversible processes, p. 294-315.

The crystal structure is described. Two kinds of charge are of importance, an ion and a "Bjerrum fault". (The latter arises from the rotation of a water molecule, bringing two hydrogen atoms (instead of the usual one) between a neighbouring pair of oxygens.) These faults can migrate through the crystal as the result of rotation of water molecules, hence each ion will be surrounded by a Debye-Hückel atmosphere of Bjerrum faults, partly screening its charge. Various properties of ice are satisfactorily interpreted by means of this model. H.N.V.Temperley

530.16 : 532.7

16653 ON DIFFUSION IN SIMPLE LIQUIDS. G.C.Castagnoli and F.P.Ricci.
Thermodynamics of irreversible processes, p.316-17.

Some experimental results on the motion of tracers in simple liquids are interpreted in terms of an activation energy. It is hoped that these may provide a comparison with the theoretical expressions for transport coefficients mentioned in earlier lectures. H.N.V.Temperley

GENERAL MECHANICS

531.25 : 681.142

16654 USE OF AN ELECTRICAL ANALOGUE FOR THE SOLUTION OF A VARIETY OF TORSION PROBLEMS. S.C.Redshaw.
Brit. J. appl. Phys., Vol. 11, No. 10, 461-8 (Oct., 1960).

A brief review of Saint-Venant torsion theory is given and the advantages and disadvantages of the various forms in which the equations can be expressed are discussed in relation to electrical analogue computation. It is shown how, by the use of a simple passive resistance network, solutions can easily be obtained both for simply connected regions as well as for the analytically difficult problem of multiply connected regions. Examples of the application of the electrical-analogue method to the problems of plastic torsion, the torsion of compound bars, thick hollow sections and thin-walled sections filled with a dissimilar material, are given.

531.25

16655 NOTE ON THE TORSION OF A CURVED ROD OF CIRCULAR CROSS-SECTION WITH TRANSVERSE ISOTROPY. S.B.Dutt.
Indian J. theor. Phys., Vol. 6, No. 4, 91-6 (Dec., 1958).

The problem of the torsion of a curved rod of circular cross-section with transverse isotropy is investigated. An exact solution is obtained by introducing a single stress function satisfying a partial differential equation which is solved with the use of toroidal coordinates.

531.3

16656 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 10. AIR-SUSPENDED PUCKS FOR MOMENTUM EXPERIMENTS. R.G.Marcley.
Amer. J. Phys., Vol. 28, No. 7, 670-4 (Oct., 1960).

This article is a description of air-suspended "pucks" for investigating the conservation of momentum between two colliding bodies. The film of air separating the pucks from their supporting surface provides an extremely small coefficient of friction. The experiment confirms that momentum is conserved with errors of less than 5%. The operating principles of these devices are easily applicable to other experiments requiring motion with negligible friction.

531.3

16657 EXACT SOLUTION OF THE BURIED LINE SOURCE PROBLEM FOR A UNIFORMLY MOVING LINE SOURCE. M.Mitra.
Bull. Calcutta Math. Soc., Vol. 51, No. 3, 109-15 (Sept., 1959).

The two-dimensional elastic displacement is determined as a function of position and time in the case when a dilatational line so is created in a semi-infinite isotropic elastic solid and subsequent moves uniformly parallel to the plane boundary. J.G.Oldro

531

16658 EFFECT OF A RESISTING COUPLE ON THE ROTATIONAL MOTION OF A RIGID BODY. T.Nonweil
Nature (London), Vol. 187, 311 (July 23, 1960).

It is shown that a retarding couple applied about the instantane axis of rotation tends to cause that axis to approach the axis of greatest moment. The converse of the theorem is stated and prove H.Morris

531

16659 THE EXISTENCE OF OSCILLATORY MOTIONS IN TH THREE-BODY PROBLEM. K.Sitnikov.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 303-6 (July 11, 1960). In Russian.

Two of the masses are equal and define the xy-plane of a rectangular inertial system OXYZ. M_3, which moves along the z-axis, is (1) infinitely small, or (2) small but finite. If $\phi(0)$ is the angular coordinate of M_1 at $t = 0$, and if $v(0)$ is the initial velocity of M_3 along OZ, then it is proved that for any value of $\phi(0)$ and any arbitrary sequence $\{S_k\}$ (tending to infinity), there exists a $v(0)$ suc that M_3 passes through the centre of gravity of the two equal mass an infinite number of times, receding from it after the k-th passag to a distance greater than S_k, provided that in case (2), M_3 is sufficiently small. In case (2), the distance between M_1 and M_2 is shown to be always less than the major axis of the ellipse they wou follow in the absence of M_3. G.A.Chisnal

531.3 : 530.1

EQUIVALENCE PRINCIPLE "PARADOX" IN THE MOTION OF A GYROSCOPE. See Abstr. 16590

MECHANICAL MEASUREMENTS

531.71 : 535.3

16660 THE POSSIBILITY OF USING ABSORPTION LINES AS A PRIMARY LENGTH STANDARD. W.G.Fastie.
J. Phys. Radium, Vol. 19, No. 3, 405-8 (March, 1958). In French.

It is possible to establish conditions of pressure and temperature in an absorbing gas so that its absorption lines are invariant in wavelength, whereas emission lines are subject to wavelength shifts dependent upon the condition of excitation. Experimental limitations have, however, restricted work on the primary length standard to emission lines. The development of techniques are described which make it possible to achieve comparable measurement accuracy with absorption lines of I_2 vapour at a pressure of 2 μ and at a temperature of 250°K. A Hg^{198} source was viewed along a variable magnetic field. A quarter wave plate in combination with a polaroid sheet isolated one of the Hg 5461 components which illuminated a long path Fabry–Perot interferometer-monochromator which was scanned by variation of air pressure. When the I_2 absorption tube was placed in the light path, the magnetic field could be adjusted until one of several I_2 absorption lines overlapped the Hg line. The shape of the absorption line was measured photoelectrically by scanning the interferometer. Likewise photographs of the Fabry–Perot patterns in absorption were obtained. The half width of the two lines which have been carefully studied was found to be 0.030 wave numbers, about 2.5 times the theoretical Doppler width, presumably due to the nuclear spin effect of I^{127}. In spite of the wid of the lines, their absolute invariance in wavelength makes them appear to be at least comparable to presently proposed emission line standards. However, the presence of the nuclear spin effect precludes the possibility of narrowing the lines by molecular beam techniques.

531.71 : 535.41

16661 NEW TECHNIQUES IN INTERFEROMETRIC METROLO AT THE NATIONAL RESEARCH COUNCIL OF CANADA. K.M.Baird.
J. Phys. Radium, Vol. 19, No. 3, 384-9 (March, 1958). In French.

Deals with some of the new techniques which are being used to assist in the redefinition of the international metre. The first of these is a method of cyclical scanning of the interference fringes formed by the Fabry–Perot etalon. The scanning is done by ssure changes in the atmosphere surrounding the etalon. This hod has been applied to the measurement of small wavelength ts. A modification of this technique, using a photographic ord, enables a great many spectral lines to be recorded simuleously. An interferometer, based on Michelson's type, makes use technique whereby precise determination of the order of interence can be made conveniently; it enables line standards of length e calibrated as easily as end standards.

531.71

16662 VERNIER SCALE ARRANGEMENT FOR THE MEASUREMENT OF PEAK HEIGHTS ON MASS ECTROMETER CHARTS. J.R.Richards.

sci. Instrum., Vol. 37, No. 9, 358 (Sept., 1960).

A rule with vernier is described, by which measurement of k height is facilitated. A convenient method of using the device conjunction with a mass-spectrometer is described.

E.G.Knowles

531.76

16663 THE DEVELOPMENT AND CALIBRATION OF QUARTZ ACCELEROMETERS. C.R.Maguire.

ust. Beihefte [Acustica], No. 1, 196-9 (1956).

Describes the development of a quartz crystal accelerometer ad suitable for general vibration measurement. Various calibran methods are described including a reciprocity method which es not involve the use of special equipment.

531.78

16664 ROBUST AND SENSITIVE SPOON GAUGE. B.J.Aylett.

sci. instrum., Vol. 37, No. 9, 362 (Sept., 1960).

531.78 : 534.22

16665 PIEZOELECTRIC PRESSURE GAUGES FOR USE IN A SHOCK TUBE. J.H.Gerrard.

custica, Vol. 9, No. 1, 17-23 (1959).

The requirements for a gauge for the measurement of pressure the wall of a shock tube are discussed and previous attempts to eet these requirements are reviewed. Two barium titanate essure gauges are described which have a response time of about μs. The spurious fluctuations in the response following a shock ave have been reduced to small magnitude.

MECHANICS OF FLUIDS

(See also Magnetohydrodynamics)

532.1

16666 A GRAPHICAL METHOD FOR DETERMINING THE COEFFICIENT OF VISCOSITY OF NEWTONIAN QUIDS USING AN OSCILLATING CYLINDER VISCOMETER. II.

i Abdel Kerim Ibrahim.

angew. Math. Phys., Vol. 8, No. 1, 74-5 (1957).

The variation of the phase angles between the two concentric linders as a function of the frequency of the outer cylinder is nsidered. The effective depth of immersion of the cylinder is the me as the actual depth.

R.Schnurmann

532.1

16667 THEORY OF OSCILLATION TYPE VISCOMETER: THE OSCILLATING CUP. I. J.Kestin and G.F.Newell.

. angew. Math. Phys., Vol. 8, No. 6, 433-9 (1957).

Deals with the theory of oscillation type viscometers with rticular emphasis on those in which a finite right circular cylinder up or disk) oscillates in contact with a fluid. The purpose is to tain formulae which relate the density and viscosity of the fluid the frequency and logarithmic decrement of the oscillation and e various physical properties of the suspension system. The udy includes an accurate analysis of the fluid motion in the cinity of the edges since this is the main source of error in most isting theories. A general formulation of the problem is given gether with an exact solution (including transients) for the scillating cup viscometer with the fluid inside the cup.

532.1

16668 THEORY OF OSCILLATION TYPE VISCOMETERS: THE OSCILLATING CUP. II. D.A.Beckwith and G.F.Newell.

. angew. Math. Phys., Vol. 8, No. 6, 450-65 (1957).

The emphasis in this part is on inquiring how the frequency and decrement of the oscillation are related to the viscoscity and density of the fluid for cups of various shapes and sizes. In particular,, estimates are made of the errors that would result from calculations of the viscosity and density from observed values of the frequency and decrement and known experimental incertainties of the latter. Methods are also described which enable one to perform these calculations explicitly.

532.1

16669 THEORY OF OSCILLATION TYPE VISCOMETERS. III. A THIN DISK. A.G.Azpeitia and G.F.Newell.

Z. angew.Math. Phys., Vol. 9a, No. 2, 97-118 (1958).

The small amplitude oscillation of a thin disk of finite radius suspended in an "infinite" fluid is considered with a view toward its use as a viscometer. The fluid motion is analysed under the assumption that the boundary layer thickness of the fluid is small compared with the radius of the disk but large compared with the thickness of the disk. Formulae are obtained relating the frequency and decrement of oscillation to the density and viscosity of the fluid.

532.1

16670 THEORY OF OSCILLATION TYPE VISCOMETERS. IV. A THICK DISK. A.G.Azpeitia and G.F.Newell.

Z. angew. Math. Phys., Vol. 10, No. 1, 15-34 (1959).

The viscous drag exerted by a fluid on an oscillating disk is determined by methods similar to those used in the preceding abstract. However, the boundary layer thickness is assumed here to be small compared with both the thickness and the radius of the disk. An extrapolation of the formulae derived agree sufficiently well, however, with those derived for the thin disk (boundary layer thickness large compared with the thickness but small compared with the radius) that it is possible to make an interpolation between the present formulae and those of Pt III that will permit the evaluation of the drag for arbitrary shape disks provided the boundary layer thickness is small compared with the radius.

532.1

16671 THEORY OF OSCILLATION TYPE VISCOMETERS. V. DISK OSCILLATING BETWEEN FIXED PLATES.

G.F.Newell.

Z. angew. math. Phys., Vol. 10, No. 2, 160-74 (1959).

A disk oscillating between two fixed plates is considered as an instrument for absolute measurements of viscosity. The existing theories relating the viscosity to the decrement of oscillation are improved by calculating the effects of the edge. This is done by assuming that the separation between the plates is small compared with both the radius of the disk and the boundary layer thickness. A comparison is made with the experimental data of Kestin and Pilarczyk [Transactions of the American Society of Mechanical Engrs, Vol. 76, 987 (1954)] for which the present theory is estimated to be correct to 0.1%.

532.5

16672 INTERIOR REGULARITY OF WEAK SOLUTIONS OF THE TIME-DEPENDENT NAVIER—STOKES EQUATION.

T.Ohyama.

Proc. Japan. Acad., Vol. 36, No. 5, 273-7 (May, 1960).

532.5

16673 A METHOD OF "FUNCTIONAL KINEMATICS" IN HYDRODYNAMICS. J.J.Moreau.

C.R. Acad. Sci. (Paris), Vol. 249, No. 21, 2156-8 (Nov. 23, 1959).
In French.

Mathematical. The movement of an incompressible fluid in a fixed domain is related to the motion of a hypersolid, of an infinite number of dimensions, about a fixed point. The motion of the fluid is supposed to be made up of elementary vector fields, each of which satisfies a certain condition. Those vector fields which are independent of time are likened to co-ordinates, those which are "transported by the fluid" (this term being defined in a special way) are likened to the vectors in the moving hypersolid. If the fluid is viscous, the corresponding motion of the hypersolid is damped. Various applications of this theory are proposed.

H.N.V.Temperley

532.5 : 538.27

16674 THE APPLICATION OF MAGNETIC NUCLEAR RESONANCE IN FLUID HYDRODYNAMICS.

A.Z.Hrynkiewicz.

Acta phys. Polon., Vol. 17, No. 5, 353-9 (1958).

The recording of the nuclear resonance line by means of a mirror oscillograph has made it possible to employ the phenomenon of non-adiabatic transition in a stream of flowing fluid for studying the character of the flow. Non-adiabatic transition was used to mark the flowing fluid in a given section of a pipe in a time of the order of a microsecond. The nuclear resonance apparatus served the detector of the marked fluid after it has traversed a certain distance in the pipe. In order to illustrate the method the shape of pulses in the detector was studied for laminar and for turbulent flow in a smooth cylindrical pipe.

532.5

16675 CHARACTERIZATION OF STATIONARY MOTION IN HYDRODYNAMICS. H.Müller.

Z. angew. Math. Phys., Vol. 9a, No. 4, 389-92 (1958). In German.

Helmholtz and Korteweg propose that the steady motion of a viscous fluid under constant extraneous forces having a single-valued potential dissipates (for any given region and assuming that inertia terms in the dynamic equations can be neglected) less energy than any other motion with the same values of velocity at the boundary. A generalization of this proposition is given, and an application discussed. The application deals with the motion of a simple macromolecule model in an inhomogeneous field of flow — a motion caused only by the influence of Stokes' friction.

532.5

16676 STEADY FLOW OF LINEAR FLUENT MATERIAL PAST A FIXED SPHERE. P.D.S.Verma.

J. Assoc. Appl. Physicists, Vol. 5, 6-9 (1958).

The problem of steady flow past a fixed sphere has been solved for incompressible fluent material recently introduced by Noll (1955) as a special type of hygrosteric material. It is found that when the viscosity constant vanishes the material behaves like ordinary perfect liquid.

532.5

16677 SOLUTION OF THE LAMINAR BOUNDARY LAYER ENERGY EQUATION AT HIGH PRANDTL NUMBERS.

A.Acrivos.

Phys. of Fluids, Vol. 3, No. 4, 657-8 (July-Aug., 1960).

A similarity transformation is obtained, which makes possible various generalizations of a result obtained by Lighthill (Abstr. 7189 of 1950). Among new problems that can be so treated are forced convection from a non-isothermal surface and forced convection from an isothermal surface to a fluid whose properties vary with temperature. H.N.V.Temperley

532.5

16678 ON THE MECHANISM OF TURBULENT MASS TRANSFER IN THE IMMEDIATE VICINITY OF A WALL.

E.Ruckenstein.

Rev. de Physique (Bucarest), Vol. 4, No. 4, 397-407 (1959).

Stud. Cercetari Fiz., Vol. 10, No. 1, 133-44 (1959).

The two models suggested previously by the author (Revue de Chimie, Vol. 8, 749, 1958 and Chem. Eng. Sci., Vol. 7, 265, 1958) for the structure of the layer in the immediate vicinity of a wall are considered without the previously assumed simplifications. S.Weintroub

532.5

16679 RESISTANCE ON A CIRCULAR CYLINDER DUE TO ANY NUMBER OF VORTICES LYING IN TWO ROWS.

D.Roy.

Z. angew. Math. Phys., Vol. 10, No. 5, 502-8 (1960).

Considers instantaneous (and not time average) resistance experienced by a circular cylinder due to uniform flow in the presence of Karman's vortex street whose axis is parallel to the direction of flow. J.K.Skwirzynski

532.5

16680 DIFFUSION OF VORTICITY IN VISCO-ELASTIC LIQUIDS. S.K.Sharma.

J. Assoc. Appl. Physicists, Vol. 5, 1-5 (1958).

The hydrodynamical equations for the diffusion of vorticity in viscoelastic liquids are set up. The effect of elasticity of liquid on the diffusion of vorticity has been investigated for a plane vortex sheet and for the line vortex filament. It is found that the elastic elements in viscous liquids slow down the rate of diffusion of vorticity.

5

16681 TRANSVERSE OSCILLATIONS OF A LIQUID JET. I J.B.Brackenridge.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1237-42 (Oct., 1960).

Observations have been made of a thin rectangular jet whic issues from an orifice and impinges upon the apex of a rigid we which is parallel to the plane of the jet. Such a system displays steady motion or motion corresponding to one of a unique set of ordered oscillatory modes. Which state of motion occurs at a g time depends upon stream thickness, orifice-to-edge distance, stream velocity, kinematic viscosity, and the previous history of the jet. The investigation is divided into two main parts. One d with the ranges of parameters of the system for which it will ex self-maintained oscillations of a given mode; the other treats frequency characteristics for the different modes. It is found th self-maintained oscillations exist in fluids with a wide range of viscosity. The frequency characteristics are obtained by both optical and acoustical methods; an empirical formula for the frequency is developed.

53

16682 FORMATION OF AIR BUBBLES IN AIR-SATURATED WATER AT REDUCED PRESSURE AND THEIR INDI TION BY AN ACOUSTICAL MEASURING PROCEDURE.

H.J.Naake, K.Tamm, P.Dämmig and H.W.Helberg.

Acustica, Vol. 8, No. 3, 142-52 (1958).

With the aid of sound-absorption measurements the formatio of bubbles in water saturated with air was investigated. The bub occur when the static air pressure in the sample holder is reduc gradually or in steps. The formation of bubbles is reduced when water is subjected to a pressure greater than atmospheric before commencing the experiment. The behaviour of air pockets adher to solids and of air-filled pores in the walls of the container or in solid particles under conditions of increased or of decreased pres ure was considered. Calculations of the growth and ascent of bub and the sound absorption caused thereby are compared with meas ments.

53

16683 OBSERVATION OF THE FORMATION AND GROWTH OF BUBBLES IN WATER CONTAINING AIR, BY OPTICAL METHODS.

H.J.Naake, K.Tamm, P.Dämmig and H.W.Helberg.

Acustica, Vol. 8, No. 4, 193-6 (1958).

With the help of a movie-camera the formation of bubbles in water after a reduction of the static pressure was examined. A suspension of solid particles to act as nuclei was added to the wa The number of bubbles formed per unit time, the rate of growth, the time interval between reduction of pressure and the moment when the bubbles can first be seen were measured. From these data the number and size of the bubble-generating nuclei can be deduced.

53

16684 GROWTH OF VAPOR BUBBLES IN A RAPIDLY HEATED LIQUID. S.A.Zwick.

Phys. of Fluids, Vol. 3, No. 5, 685-92 (Sept.-Oct., 1960).

The earlier theory (Abstr. 5541 of 1954) of the growth of vap bubbles in superheated liquids is extended to the situation in whic the rate of temperature rise of the liquid is large. Numerical so lutions are presented for the early stages of bubble growth for various rates of liquid temperature rise. The asymptotic behavi of a bubble is found explicitly for a temperature rise of the liquid which is linear in time. In this case the bubble radius grows initially as $t^{1/2}$, as in asymptotic solutions found previously for small rates of temperature rise, but then deviates toward a late $t^{2/3}$ variation.

LIQUID STATE

(Liquid helium is included under Low-Temperature Physics)

532

16685 ON THE HYPER-CHAIN APPROXIMATION IN THE THEORY OF CLASSICAL FLUIDS. G.S.Rushbrooke.

Physica, Vol. 26, No. 4, 259-65 (April, 1960).

The nonlinear integral equation for the hyper-chain approxima tion to the radial distribution function of a classical fluid is derived, and it is shown that when linearized it is equivalent to the linearized form of Born—Green theory.

532.7 : 533.7

6686 APPROXIMATIONS IN THE THEORY OF DENSE FLUIDS. F.H.Stillinger,Jr.

. of Fluids, Vol. 3, No. 5, 725-32 (Sept.-Oct., 1960).

A fluid of rigid spheres in equilibrium is considered from a point which allows the deduced equation of state to reflect very itively the accuracy of two approximations to the triplet ibution function. Specially, these approximations are: (1) the l Kirkwood superposition scheme, and (2) assumption that the elation of excess particles near a fixed particle pair is ively composed of the excesses induced individually by each ber of the pair (linear correlation field hypothesis). Granted these hypotheses, each in turn, the rigorous statistical hanical relations between rigid-sphere distribution functions and hermodynamic pressure and compressibility lead unambigously onlinear first-order differential equations for the pressure as a tion of density. The simply obtained numerical solutions rly demonstrate that assumption (1) is considerably superior to

532.7

6687 CONTINUUM-MODEL TREATMENT OF LONG-RANGE INTERMOLECULAR FORCES. I. PURE SUBSTANCES.

nder.

hem. Phys., Vol. 33, No. 3, 668-75 (Sept., 1960).

A theory is presented whereby the long-range intermolecular es, including the London dispersion forces, of pure nonelectro- s may be calculated from optical and dielectric data. The hod is based on the continuum-model approach, where one mole- is treated explicitly while the others are replaced by a medium niform dielectric. The classical and quantum-mechanical llators are used as working models and expressions are derived computing the cohesive energy appropriate for both types of llators. The potential energy based on the quantum-mechanical llator is calculated for a number of liquids and is shown to be in agreement with the experimental energy of vaporization.

532.7 : 539.2 : 548.5

REDUCED TEMPERATURES FOR NUCLEATION IN SUPER- OLED LIQUIDS. See Abstr. 16267

532.7 : 536.42

16688 NOTE ON EVAPORATION.
S.A.Zwick.

ppl. Phys., Vol. 31, No. 10, 1735-41 (Oct., 1960).

A simple kinetic model is employed to investigate nonequilibrium poration from a liquid. Molecules are assumed to evaporate into one-sided) Maxwellian velocity distribution at the liquid surface. lecules reaching the surface from the vapour are assumed to m part of an ellipsoidal velocity distribution. Of the molecules roaching the liquid at the interface only the fraction α condenses re; the remainder is taken to undergo specular reflection back the vapour. By equating physical conditions at the surface with ditions in the vapour, one can relate the vapour pressure to that ch would prevail at equilibrium, as a function of the surface ommodation coefficient α and the mean velocity u of the vapour ative to the interface.

532.7

16689 HOLE MODEL FOR DIFFUSION IN LIQUIDS.
R.B.Gordon.

a metallurgica, Vol. 7, No. 10, 681-2 (Oct., 1959).

Suggests that a number of the difficulties of the vacancy model diffusion in liquid metals may be overcome if the free volume ocalized in a number of small holes, instead of single vacancies.

H.Mykura

532.7 : 530.16

ON DIFFUSION IN SIMPLE LIQUIDS. See Abstr.16653

532.7

16690 ON THE STRUCTURE OF DILUTE SOLUTIONS OF METALS. E.C.Evers.

chem. Phys., Vol. 33, No. 2, 618-19 (Aug., 1960).

Disputes the validity of a recent claim by Symons (Abstr. 9305 1959) that the properties of dilute solutions of metals are ade- ately accounted for in terms of two solute species, trapped elec- ons and "pairs" formed of two electrons and two metal ions. It is aimed that analysis of recent data on conductance points to the cessity of postulating a third solute species, the "monomer" rmed of one electron and one metal ion.

H.N.V.Temperley

532.7

16691 INVESTIGATION OF THE STRUCTURES OF LIQUID ALLOYS OF Cd—Sn. N.V.Alekseev and A.M.Evseev.

Kristallografiya, Vol. 4, No. 3, 348-52 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 323-7 (March, 1960).

A study was made by electron diffraction of five alloys of Cd and Sn with Cd concentrations between 15 and 65 wt.%. Coordination numbers were calculated from the radial distribution curves. No maxima were observed other than those characteristic of Cd and Sn.

J.Thewlis

532.7

16692 AN X-RAY STRUCTURE INVESTIGATION OF THE LIQUIDS OF SODIUM, POTASSIUM AND SODIUM—POTASSIUM ALLOYS. B.R.Orton, B.A.Shaw and G.I.Williams.

Acta metallurgica, Vol. 8, No. 3, 177-6 (March, 1960).

The X-ray structures of liquid sodium, potassium and sodium—potassium alloys have been investigated by an improved method. By using a reservoir technique a plane horizontal surface of liquid metal has been examined by a monochromatic X-ray beam in a focusing Geiger diffractometer. Thus the absorption correction, which is one of the greatest sources of error in previous work, is constant and omitted from the analysis. The radial distribution method of analysis has been used to interpret the results. None of the liquids examined shows evidence of structure other than that associated with a statistical mixture of atoms. In particular the position of the intensity peak is found to depend in a fairly simple way on alloy composition and does not show the marked deviation at compound composition Na_2K as reported by other workers. The use of the radial distribution method has been examined critically. It is felt that the method is adequate for interpreting simple liquid structures provided suitable modification functions are used to expose spurious detail.

532.7

16693 ON THE RESISTIVITY AND KNIGHT SHIFT OF LIQUID ALLOYS OF SODIUM. E.Daniel.

J. Phys. Chem. Solids, Vol. 13, No. 3-4, 353-5 (June, 1960). In French.

The standard model for solid alloys in which the foreign atoms are represented by square-well potentials is extended to liquid alloys of Na. It leads to values of the increase of resistivity, and change of the Knight shift, with concentration of the foreing atoms, in agreement with experimental results, except when the electronegativity of the dissolved metal is very different from that of Na.

L.Pincherle

532.7 : 539.2 : 537.311

SEMICONDUCTING PROPERTIES OF SERUM ALBUMIN SOLUTIONS. See Abstr.15970

532.7

16694 THEORY OF DILUTE HIGH POLYMER SOLUTIONS. II. W.R.Krigbaum, D.K.Carpenter, M.Kaneko and A.Roig.

J. chem. Phys., Vol. 33, No. 3, 921-7 (Sept., 1960).

For Pt I, see Abstr. 6710 of 1958. The second virial coefficient is calculated according to the smoothed distribution method. This treatment differs from those of Flory—Krigbaum and Isihara—Koyama through inclusion of the numerous short-range intramolecular contacts arising by virtue of the connected nature of the chain. The result is to replace the previous F(X) by F(X,ρ), where the parameter ρ depends upon the ratio of the total number of intramolecular contacts to the number of long-range contacts counted using a radial segment distribution. The number of intermolecular contacts created when two molecules overlap is estimated by the use of an additional smoothed radial segment distribution which is assumed to be uniformly expanded by intramolecular excluded volume effects. Comparison with experiment reveals that both the temperature and molecular weight dependences of A_2 in the vicinity of the θ temperature are described in a reasonably quantitative fashion by the present treatment. In this case there are no adjustable parameters. Furthermore, satisfactory agreement is observed for good solvents using values for the thermodynamic interaction parameter deduced from intrinsic viscosity. In the limit $\rho = 1$ the present treatment yields a result equivalent to those of the previous workers. It is concluded that the latter underestimate the number of intramolecular contacts through neglect of the connected nature of the chain. In the other limit, $\rho = 0$, a result approximating that of the Casassa—Markovitz treatment is obtained. It is believed that their assumption of a spherical segment distribution about the initial point of contact results in an overestimation of the number of intermolecular contacts.

532.7

16695 CONTRIBUTIONS TO THE INTERPRETATION OF THE SONIC VELOCITY IN BINARY LIQUID MIXTURES.

R.Genähr.

Acustica, Vol. 8, No. 3, 153-9 (1958). In German.

The dependence of the velocity of sound on the concentration is discussed in terms of the semi-empirical relations $R = u^{1/3}M/\rho$ and $u = u_\infty sB/V$ established by Rao and Schaaffs. When the velocity of sound is plotted against the concentration, the result permits a qualitative interpretation. For mixtures with components not having heavy atoms or extremely high velocities of sound, it is also possible to establish a quantitative interrelation between the velocity of sound and the density as a function of the concentration. For sound-dispersing fluids, the possibility is pointed out of measuring the dispersion at constant frequency as a function of the temperature.

532.7

16696 ULTRASONIC ABSORPTION AND VELOCITY IN MOLTEN SALTS.

R.W.Higgs and T.A.Litovitz.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1108-15 (Sept., 1960).

Measurements of ultrasonic absorption and velocity were made in the molten salts KNO_3, $NaNO_3$, $AgNO_3$, $LiNO_3$, $CdCl_2$ and the molten salt mixture $NaNO_3-KNO_3$. The results indicate that these molten salts exhibit a structural viscosity similar to that found in water and associated organic liquids. The ratio of bulk to shear viscosity (η_B/η_S) ran high as 10 in KNO_3 and as low as 1.7 in $CdCl_2$. In the Group I nitrates, the ratio η_B/η_S was found to be directly proportional to the volume of the cation. The $\ln \eta_B/\eta_S$ was found to be a linear function of the entropy of fusion. Consideration of the ultrasonic data in the primary alcohols showed that here also the $\ln \eta_B/\eta_S$ is a linear function of the entropy of fusion when considering an homologous series. These results indicate that the structural relaxation process in both the ionic and organic liquids involves considerable randomization of the quasi-crystalline liquid lattice.

532.7 : 541.13 : 534.22

ULTRASONIC VELOCITIES IN AQUEOUS ELECTROLYTE SOLUTIONS. See Abstr. 16769

532.7 : 537.2

16697 AZEOTROPISM AND DIELECTRIC BEHAVIOUR.

C.V.Suryanarayana and K.M.Somasundaram.

Z. Naturforsch, Vol. 15a, No. 5-6, 551-2 (May-June, 1960).

Measurements of the dielectric constant at 1.8 Mc/s, 35°C, have been made on a number of binary liquid mixtures which show azeotropism. Curves of permittivity against concentration show no dielectric anomaly at the azeotropic composition. L.E.Cross

532.7 : 537.2

16698 INFLUENCE OF QUADRUPOLAR MOMENTS ON THE DIELECTRIC CONSTANT OF A POLAR LIQUID.

A.R.Ferchmin.

Acta phys. Polon., Vol. 18, No. 2, 133-42 (1959). In French.

Onsager's theory is extended using Böttcher's model of an eccentric dipole in a spherical dielectric continuum (Theory of Electric Polarization, Amsterdam, 1952). It is shown that corrected values for the dipolar moments of certain halogenated hydrocarbons can be derived from the resultant calculation for the polarization per unit volume (cf. Abstr. 5836 of 1956). J.H.Mason

532.7 : 537.2

16699 PHOTO-INJECTION OF CHARGE INTO DIELECTRIC LIQUIDS.

M.J.Morant.

Nature (London), Vol. 187, 48-9 (July 2, 1960).

The increase of the electrical conductivity of highly purified n-hexane by ultraviolet illumination of the electrodes is reported. The conductivity was increased by a factor of 10^3 from the dark conductivity of 10^{-17} mho/cm. The lack of saturation with increasing applied voltage indicated that photo-injection of charge was occurring rather than photo-electric emission. A mobility of 5×10^{-4} cm^2/volt sec was measured for the charge carriers.
R.G.C.Arridge

532.7 : 537.2

16700 MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. XXX. THE ANOMALOUS DIELECTRIC RELAXATION OF DIPHENYL ETHER AND SOME SIMILAR MOLECULES.

D.M.Roberti, O.F.Kalman and C.P.Smyth.

J. Amer. Chem. Soc., Vol. 82, No. 14, 3523-6 (July 20, 1960).

For Pt XXIX, see J. Amer. Chem. Soc., Vol. 82, No. 9, 2106 (May 5, 1960). Dielectric relaxation times have been determined for diphenylmethane, benzyl ether, bibenzyl and dibenzyl ether, as pure liquids, to be compared with previous values for diphenyl and benzophenone. All the measured compounds have relaxatio times comparable to that for diphenyl ether, very low in compa to that for benzophenone. In addition, the relaxation time of dip nyl ether measured in Nujol has been found to be relatively ins sitive to viscosity and temperature. The results indicate that s form of intramolecular motion is responsible for the small rel tion time. Several previously proposed mechanisms are discus

532.7 :

16701 DIELECTRIC RELAXATION OF ISOAMYL BROMID

S.H.Glarum.

J. chem. Phys., Vol. 33, No. 3, 639-43 (Sept., 1960).

The complex dielectric constant of isoamyl bromide was measured at 1, 3, and 9 kMc/s between −75° and 25°C. Comple plane plots indicate an asymmetric, skewed-arc distribution of relaxation times, with the shape of the distribution function not appreciably temperature dependent. A defect diffusion model is proposed to explain the dielectric behaviour of this system. Th model implies that the relaxation of a molecule is more probabl immediately after one of its neighbours has relaxed than at an arbitrary time. A distribution of relaxation times is derived wh under the appropriate conditions, closely resembles that of the empirical skewed-arc function.

532.7 :

16702 EFFECTS OF PRESSURE ON DIELECTRIC RELAX IN A CHLORINATED DIPHENYL.

T.A.Perls and L.B.Wilner.

J. chem. Phys., Vol. 33, No. 3, 753-9 (Sept., 1960).

Data are presented on the dielectric properties of a comme chlorinated diphenyl, Aroclor 1260, over a wide range of freque and temperatures, and also over a range of pressures up to 200 at four fixed temperatures from 17 to 51°C. The data are comp with acoustical-relaxation data previously obtained, and with viscosity—temperature data for the same material. Similar dat from the literature, are evaluated for glycerol. The ratio η/τ_D is calculated over a range of temperatures for Aroclor 1260 and a range of pressures for glycerol. The Aroclor 1260 data provi strong evidence against the applicability to this material of Deb simple hydrodynamic model of a spherical dipole in a viscous medium. A distribution of relaxation times is observed, and it pointed out that, while this may be due, in part, to the variety of molecules in the Aroclor, it may also be ascribed to the variety configurations in the vicinity of each molecule, including various degrees of association. Several additional lines of research are suggested. The term "piezopermittivity" is proposed for the pr of certain materials, such as the Aroclors, which results in larg changes in permittivity with pressure. Possible applications of piezopermittivity are discussed.

532.7 : 53

16703 STREAMING BIREFRINGENCE OF RIGID MACROMOLECULES IN GENERAL TWO-DIMENSIONAL LAMINAR FLOW.

H.Wayland.

J. chem. Phys., Vol. 33, No. 3, 769-73 (Sept., 1960).

Quantitative expressions for the direction of the angle of iso and for the amount of birefringence due to a dilute solution of rig macromolecules in a general two-dimensional laminar flow are derived. If E is the principal strain rate and Λ_0 is the angle betw the streamline direction and the direction of the principal strain axis, the angle of isocline, measured from the first principal stra rate axis is

$$\chi = -(E \sin 2\Lambda_0/6D)\{1 - (E^2/27D^2)[\sin^2 2\Lambda_0 + (24b^2/35)] + \cdots\}$$

where $b = [(a_1^2 - a_2^2)/(a_1^2 + a_2^2)]$ is a shape factor for an ellipsoid revolution of semimajor axis a_1 and semiminor axis a_2 and D is th rotary diffusion constant for this ellipsoid. The amount of birefringence is

$$\Delta n = (4\pi/15)(cGEb/nD)\{1 - (E^2/18D^2)[\sin^2 2\Lambda_0 + (6b^2/35)] + \cdots$$

where n is the mean index of refraction of the solution, c the volu concentration of the macromolecules, and $G = g_1 - g_2$ is the optica anisotropy of the ellipsoids. It is seen that if the principal strain rate is not at 45° to the streamline at the point of observation, thi will make itself felt in the position of the angle of isocline before influences the amount of birefringence. Detailed expressions for effect of polydispersity show that there is a simple relationship between the birefringence and angle of isocline measured in Coue

these quantities measured in general two-dimensional flow
) $\Lambda_0 = 45^0$ in the general flow or (b) the birefringence and
isocline values are linear with strain rate.

532.7 : 535

MEASUREMENTS OF THE OPTICAL CONSTANTS OF MERCURY AND MERCURY–INDIUM AMALGAMS IN THE
AL REGION 4000 TO 17 000 cm^{-1}. J.N.Hodgson.

g. (Eighth Ser.), Vol. 4, 183-93 (Feb., 1959).

optical constants of liquid mercury have been measured by
tion method, in the infrared spectral region 4000 to
m^{-1}. The apparatus used has two quartz Rochon prisms, a
rism spectrometer, and a lead sulphide photocell. The re-
surface was a free surface of mercury, which could be en-
n a hydrogen filled tank. The measured values do not agree
predictions of the Drude free electron theory. The dielectric
ϵ has a minimum at a wave number $\sim 9 \times 10^3$ cm^{-1}. The
ture variation of the optical constants of mercury has been
ated between 20^0 and 230^0 C. Measurements have been made
ptical constants of mercury–indium amalgams, between 0 and
ndium.

532.7 : 539.19

FECT OF SOLVENTS ON THE ELECTRONIC SPECTRA OF
IC MOLECULES. See Abstr. 15739

532.7 : 535.33

5 RELATIONS BETWEEN ULTRAVIOLET AND VISIBLE ABSORPTION PEAKS OF IODINE SOLUTIONS.

ey, D.N.Glew and J.H.Hildebrand.
. Phys., Vol. 33, No. 2, 621-2 (Aug., 1960).

he wavelengths of the absorption maxima (visible region)
tted against the ionization potentials of the solvents the
ie on a straight line of positive slope for halogenated hydro-
s (n-electron donors) and on another straight line for aro-
olvents (π-electron donors). Ultraviolet maxima also divide
ents into the same two groups. G.F.Lothian

532.7 : 535.33

6 CN STRETCHING BANDS IN THE RAMAN SPECTRA OF SOME GROUP Ib AND GROUP IIb COMPLEX CYANIDES.

antry and R.A.Plane.
. Phys., Vol. 33, No. 3, 736-40 (Sept., 1960).

e Raman spectra of solutions containing cuprous, argentous,
rcuric ions together with cyanide ions indicate the presence
di-, tri-, and tetra-coordinated complexes. The spectra
olutions containing zinc and cadmium ions, respectively, with
ions could be investigated in concentrations where only the
oordinated complex is observed.

532.7 : 535.33

07 SPECTRAL SOLVENT SHIFT. I. PARAFFIN HYDROCARBON SOLVENT INTERACTIONS WITH POLY-
AR AROMATIC HYDROCARBONS. O.E.Weigang, Jr.

. Phys., Vol. 33, No. 3, 892-99 (Sept., 1960).

e electronic shifts for 11 ultraviolet transitions of the
phores naphthalene, phenanthrene and the polar aromatic
arbon, azulene, were observed in a series of 17 paraffin
arbon solvents from isopentane to n-tridecane. The contri-
o the shift of branching and cyclization of solvent molecules
served by including the five structural isomers of hexane,
rimethylpentane and 2,2,5-trimethylhexane together with the
and methylcyclopentanes and hexanes. The statistical
ch is used to interpret the electronic shifts in terms of inter-
tentials and the solvent radial distribution function and is
ed to the McRae extension of the Bayliss solvent shift theory.
sive type potentials suffice to account for the frequency shifts
sitions, except the ^1L_b transition of azulene which shifts to the
om the vapour to hydrocarbon solutions. The behaviour can
unted for by a change in the static dipole moment of azulene
tation, a phenomenon predicted by quantum mechanical calcu-
on the molecule.

532.7 : 535.33 : 539.19

BSORPTION SPECTRA OF CONDENSED-RING AROMATICS
UTION: HIGH-PRESSURE AND LOW-TEMPERATURE
TS. See Abstr. 15733

532.7 : 535.33 : 539.19

LVENT EFFECTS ON n → π^* TRANSITIONS IN
INE. See Abstr. 15742

532.7 : 535.37

16708 THE THEORY OF LUMINESCENCE QUENCHING IN LIQUID SOLUTIONS. Yu.A.Kurskii and A.S.Selivanenko.

Optika i Spektrosk., Vol. 8, No. 5, 643-50 (May, 1960). In Russian.

General equations, which describe quenching of luminescence in solutions, are derived first and then expressions are obtained for decay laws with allowance for Brownian motion of molecules and for resonance quenching. A.Tybulewicz

532.7 : 535.37

16709 ASYMMETRICALLY BROADENED EMISSION LINES IN THE SONOLUMINESCENCE SPECTRA OF AQUEOUS SALT SOLUTIONS. E.Heim.

Z. angew. Phys., Vol. 12, No. 9, 423-4 (Sept., 1960). In German.

In addition to the continuous emission spectrum produced in gas-containing liquids by ultrasonic excitation, resonance lines of the alkali or alkaline earth metals are emitted if their salts are present in solution. A microphotometer trace is given for the sodium lines so produced from a 2N solution of NaCl in water saturated with Xe and kept near freezing point. The lines are sharp on the short wavelength side but 100 A broad on the long wavelength side. S.T.Henderson

532.7 : 535.37

16710 LIQUID SCINTILLATORS. X. SOME ARYL SUBSTITUTED PHENANTHRENES AND DIHYDROPHENANTHRENES, AND RELATED p-TERPHENYLS AND p-QUATERPHENYLS. DETERMINATION OF KALLMANN PARAMETERS.

S.P.Birkeland, G.H.Daub, F.N.Hayes and D.G.Ott.
Z.Phys., Vol. 159, No. 5, 516-23 (1960).

A number of new 2- and 2,7-aryl, substituated phenanthrenes, 3,4-dihydrophenanthrenes, and 9,10-dihydrophenanthrenes, as welll as some related p-quaterphenyls and p-terphenyls, were tested as liquid scintillation solutes. Also determined were the compounds' ultraviolet absorption spectra, ultraviolet-induced florescence spectra, and Kallmann parameters. On the basis of these measurements, it was possible to correlate to some degree structure and scintillation ability. Some interesting results regarding conjugation and co-planarity in the linear polyphenyls were also obtained.

532.7 : 535.37 : 539.2

THE MECHANISM OF SCINTILLATIONS IN ORGANIC SUBSTANCES. See Abstr. 16107

532.7 : 538.27

16711 NUCLEAR MAGNETIC RELAXATION IN A STRONGLY ASSOCIATED LIQUID. C.R.K.Murthy and R.D.Spence.

J. chem. Phys., Vol. 33, No. 3, 945 (Sept., 1960).

Measurement of T_1 at 5 Mc/s [and room temperature ?] for mixtures of phenyl isothiocyanate and diethylamine. This mixture has a viscosity maximum at 50 mole% and shows a corresponding minimum of T_1 at the same concentration. However a more detailed comparison of T_1 and viscosity shows that a more sophisticated analysis is required, as expected for this rather complex system. J.G.Powles

532.7 : 538.27 : 533.7

16712 MEDIUM EFFECTS IN THE NUCLEAR MAGNETIC RESONANCE SPECTRA OF LIQUIDS. IV. NATURE OF THE EFFECTS. A.A.Bothner-By.

J. molecular Spectrosc., Vol. 5, No. 1, 52-60 (July, 1960).

For Pt III see Abstr 8066 of 1957. Proton magnetic resonance spectra have been obtained of several simple organic compounds in the gaseious state and compared with spectra of the neat liquids and of the substances at infinite dilution in a variety of solvents. The change from the gaseous state to the liquid state is accompanied in every case by a down-field shift of the proton resonance signal in excess of that calculated using the classical $2\pi\kappa/3$ correction for the effect of bulk susceptibility. The excess shift, $\beta_i{}^j$, observed for a solute proton, i in a solvent j, can be calculated empirically using the relation $\beta_i{}^j = -x_i y_j$, where x_i and y_j are numbers characteristic of the solute and solvent, respectively. The origins of the solvent shift are discussed, and a hypothesis accounting for the observed results is suggested.

532.7 : 538.27

16713 A STUDY OF THE RELAXATION OF A PARAMAGNETIC ION BY OBSERVATION OF NUCLEAR RESONANCE SIGNALS. A.Landesman.

J. Phys. Radium, Vol. 20, No. 12, 937-48 (Dec., 1959). In French.

Dynamic polarization of protons in water containing the paramagnetic ion $NO(SO_3)_2^{--}$ was studied, both theoretically and experimentally, as a function of magnetic field. The enhancement of the proton polarization depends appreciably on the relaxation process of the electron spin and so enables one to decide which is the real relaxation process. The following two mechanisms were considered. (1) The electron spin is coupled with the nitrogen magnetic moment by hyperfine interaction; if this interaction has an anisotropic part, a relaxation process for the electronic spin will result through the Brownian motion of the ion. (2) The relaxation of the electron spin takes place through spin-orbit coupling of the electron spin. Experimental results showed that the relaxation took place through the second process. Thus with the help of dynamic polarization the relaxation of an electron spin in a liquid was studied without using an electron resonance spectrometer, simply by observing the resonance of a nuclear spin coupled with the electron spin.

532.7 : 538.27

16714 PARAMAGNETIC ELECTRON RESONANCE IN SOLUTION. D.Bösnecker and E.Lutze.
Z. angew. Phys., Vol. 12, No. 8, 354-60 (Aug., 1960). In German.

Measurements are presented of spin resonance absorption of Mn^{2+} and Cu^{2+} ions in solution in water and glycerine at 300°K and 90°K. The lines were broad and weak but hyperfine structure was observed for the Mn^{2+} at 300°K in water and for Cu^{2+} at 90°K in glycerine. The Mn^{2+} signal is different for $MnSO_4.4NH_3$ as solute rather than $MnSO_4.4H_2O$, and it is suggested that the ammonia covalent bonds to some extent to the manganese ion. J.G.Powles

532.7 : 538.27

16715 EPR STUDIES OF THE TETRACYANOETHYLENE ANION RADICAL.
W.D.Phillips, J.C.Rowell and S.I.Weissman.
J. chem. Phys., Vol. 33, No. 2, 626-7 (Aug., 1960).

The spectrum of the radicals formed by mixing solutions of tetracyanoethylene and NaI or NaCNS was found to consist of eleven lines due to hyperfine coupling with N^{14} and C^{13} nuclei. The rate of electron exchange between the anion and the parent molecule in solution was determined from the effect of added tetracyanoethylene on the resonance line widths. E.F.W.Seymour

532.7 : 538.27

16716 OBSERVATION OF THE OVERHAUSER EFFECT ON CARBON-13 NUCLEAR RESONANCE SIGNALS.
D.J.Parker, G.A.McLaren and J.J.Conradi.
J. chem. Phys., Vol. 33, No. 2, 629-30 (Aug., 1960).

Enhanced nuclear magnetic resonance signals from C^{13} nuclei of solvent molecules have been observed in solutions of free radicals using the Overhauser technique of simultaneous irradiation with microwave power at the free radical electron resonance frequency. E.F.W.Seymour

532.7 : 538.27 : 533.7

16717 ENHANCEMENT OF NUCLEAR POLARIZATION IN LIQUIDS AND GASES ADSORBED ON CARBON. EXTENSION TO SOLIDS CONTAINING PARAMAGNETIC IMPURITIES. J.Uebersfeld, J.L.Motchane and E.Erb.
J. Phys. Radium, Vol. 19, No. 11, 843-4 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A new effect (different from the Overhauser effect) for enhancement of nuclear polarization by double resonance is described; (1) a liquid or gas is adsorbed on carbon: carbon contains paramagnetic centres on its surface that can interact with the nuclear spins of adsorbed liquid or gas. The proton signal is observed in the liquid (benzene or toluene) or the gas (ammonia or hydrogen sulphide) in a magnetic field H_0 = 3000 G. The nuclear resonance signal is increased without population inversion (absorption increases) when the microwave frequency $\nu_e - \nu_N$ is applied where ν_e and ν_N are the electronic and the nuclear resonance frequencies. The nuclear resonance signal is increased with population inversion (stimulated emission) if the applied frequency is $\nu_e + \nu_N$; (2) the same effect exists with solids since it is also obtained when the adsorbed benzene is frozen, or with solids that have been irradiated to produce paramagnetic centres; (3) the enhancements obtained so far are of the order of 20 (with a microwave field of a fraction of a gauss) for a theoretical factor of 660 for protons, the maximum polarization attainable corresponding to the electron gyromagnetic factor.

532.7 : 538.27

16718 NUCLEAR MAGNETIC RELAXATION TIMES T_1 AND T_2 IN SOME LIQUIDS.
G.Bonera, L.Chiodi, G.Lanzi and A.Rigamonti.
Nuovo Cimento, Vol.17, No. 2, 198-204 (July 16, 1960).

Nuclear relaxation times T_1 and T_2 of a set of pure liquids have been measured. The results obtained give, in general, for low viscosity liquids, according to theory, $T_1 = T_2$ within the ex rimental error. The possibility is examined that in some liquid having more than one chemical type of proton, different longitudinal relaxation times are present.

532.7 : 53

16719 COMPARATIVE STUDY OF THE INFRARED ABSOR TION SPECTRA AND OF NUCLEAR MAGNETIC RES ANCE (N.M.R.) OF SOLUTIONS OF WATER IN ORGANIC SUBSTANCES. G.Mavel.
J. Phys. Radium, Vol. 20, No. 10, 834-6 (Oct., 1959). In French

The relative frequency shift $(\nu_{gas} - \nu_{soln.})/\nu$, for proton n.m is plotted against the shift, $\nu_{gas} - \nu_{soln.}$, of the OH valency vibration for some 15 solvents. The points generally lie on a str line. Tabulated results also show shifts of OD valence and OH b ing vibrations, and ionization potentials and magnetic dipole mon of some of the solvents. The relation between these last and n.m shifts is discussed. G.F.Lot

532.7 : 53

16720 EFFECTS OF PRESSURE ON PROTON SPIN-LATTI RELAXATION IN SEVERAL DEGASSED ORGANIC LIQUIDS. A.W.Nolle and P.P.Mahendroo.
J. chem. Phys., Vol. 33, No. 3, 863-7 (Sept., 1960).

The hydrogen nuclear magnetic relaxation time (T_1) for degassed samples of several organic liquids was measured, by transient method, at pressures up to 1400 kg/cm², primarily for comparison with results obtained without degassing. Certain of liquids were investigated, without degassing, by Benedek and Pu (Abstr. 2472 of 1955), who concluded that T_1 decreases under pressure less rapidly than the rates of translational processes (fluidity and diffusion). The present results confirm this for degassed methyl iodide and n-heptane, in both of which the effect of degassing is to increase T_1 less than 20%. For benzene and tolu degassing causes T_1 to increase by several hundred percent, and preceding conclusion ceases to apply, but instead, in the degasse samples, the relative rate of decrease of T_1 under pressure is comparable to that of the fluidity; in benzene, at low pressures, greater. Additional pressure studies are reported for purified cyclohexane, for purified 1,1,1-trichloroethane, and for chlorofo which was not successfully purified.

MECHANICS OF GASES

53

16721 VISCOSITY OF MIXTURES OF HYDROGEN AND WATER VAPOR AT 295°K. J.W.Fox and A.C.H.Smi
J. chem. Phys., Vol. 33, No. 2, 623-4 (Aug., 1960).

The viscosity curve had a maximum which lay nearer to $x_2 = 0$ than to $x_1 = 0$ (x_1 and x_2 are the molar fractions of hydrog and water vapour, respectively). The value of η_{mix} was about 35 greater than η, at a value of x_2 of about 0.3. Computed values of η_{mix} for a molar fraction of water vapour of 0.025 were 0.9541×10^{-4} and 0.9404×10^{-4} P, respectively. These represen increases of 7.7% and 6.2%, respectively, over the viscosity of p hydrogen and agreed reasonably well with measurements of the r of damping of the oscillations of a small pendulum at pressures where the mean free path was not negligible compared with the diameter of the bob. R.Schnurm

53

16722 ON RELATIVE MEASUREMENTS OF THE VISCOSIT OF GASES BY THE OSCILLATING-DISK METHOD.
J.Kestin, W.Leidenfrost and C.Y.Liu.
Z. angew. Math. Phys., Vol. 10, No. 6, 558-64 (1959).

Available experimental observations on a thin disk oscillatin in various gases, between two fixed parallel plates at moderate spacings agree well with the hypothesis that the edge correction factor in the formula for torque is a smooth function of the ratio boundary-layer thickness to separation. This allows an oscillati disk instrument to be calibrated when it is necessary to use the intermediate spacings at which no complete theory of the instrum is yet available. J.G.Oldr

53

16723 AN ABSOLUTE DETERMINATION OF THE VISCOSIT OF ELEVEN GASES OVER A RANGE OF PRESSURE
J.Kestin and W.Leidenfrost.
Physica, Vol. 25, No. 11, 1033-63 (Nov., 1959).

The measurements described were based on a new theory of

cillating-disk viscometer which includes the effect of the finite
as well as that of its cylindrical circumference. The theory
t compared with very precise measurements obtained in an
nent whose brief description is also given. The experiments
the theory to within 0.15% when no correction for the paddle
of the mirror is applied. The latter has been determined
cally with respect to measurements on air and with it, it is
ssible to assume that the theory holds exactly when the bound-
yer thickness is large enough, as assumed in Newell's theory
bstr. 16667-71 of 1960). The precise lower bound of the
ry layer thickness for which Newell's theory is applicable has
etermined experimentally with reference to measurements on
en. The final measurements performed at 20°C for air, argon,
dioxide, deuterium, helium, hydrogen, krypton, neon, nitro-
xygen, and water vapour, and, in addition, at 25°C for air,
nitrogen, oxygen, and xenon are believed to be accurate, on
olute basis, to 0.05% and precise to 0.01-0.07% depending on
s. A thorough statistical analysis of the present measurements
ose due to Michels and Gibson on nitrogen is given. This shows
part from being subject to a much larger standard deviation,
ter results are statistically identical with the present meas-
nts over the same range of pressures. It is, consequently,
ed that the reliability of both sets of data is very high because
ave been obtained by entirely different methods. Extensive
ical results and interpolation formulae are given.

533.6

724 AEROELASTICITY.

L.Arnold.

tiers of numerical mathematics symposium, Wisconsin, 1959
Abstr. 12232 of 1960) Paper Four, p. 59-66.

Discusses some hydrodynamic problems that arise when the
le assumption that aircraft components are rigid is dropped.

H.N.V.Temperley

533.6

725 A HYDRAULIC ANALOGUE FOR STUDYING SUPERSONIC FLOW. R.Legendre.

Acad. Sci. (Paris), Vol. 250, No. 23, 3771-2 (June 8, 1960).
ench.

The supersonic movement of a solid body through the atmos-
e can be represented by model experiments. They involve the
f a set of liquid jets to which a solid is exposed. If the
nsions of the jets comply with appropriate conditions the liquid
on the solid surface is comparable to the layer of air on the
ce of the body moving at supersonic speed. R.Eisenschitz

533.6

726 SEPARATION OF GAS MIXTURES IN A SUPERSONIC JET. II. BEHAVIOR OF HELIUM—ARGON MIXTURES
EVIDENCE OF SHOCK SEPARATION.

tern, P.C.Waterman and T.F.Sinclair.
em. Phys., Vol. 33, No. 3, 805-13 (Sept., 1960).

For Pt I, see Abstr. 10217 of 1959. Further experimental
nce is presented for the separation of gas mixtures in the
rsonic jet formed by a Laval nozzle. The results are in agree-
with a separation theory based on free-molecule kinetics. In
ion, anomalies are observed which can be attributed to pressure
sion effects generated during passage through an oblique shock
located at the exit plane of the nozzle.

533.6

6727 OPTICAL STUDY OF BOUNDARY-LAYER TRANSITION PROCESSES IN A SUPERSONIC AIR STREAM.

Spangenberg and W.R.Rowland.
. of Fluids, Vol. 3, No. 5, 667-84 (Sept.-Oct., 1960).

A sequential-spark schlieren system with cylindrical-lens
era was used to trace the history of transition from laminar
rbulent flow on a cylindrical model in a Mach number 1.96 air
m. Both smooth and rough models were tested at several
olds numbers per unit length. The results showed that tran-
n in a supersonic stream starts with high-frequency distur-
es in the laminar boundary layer which degenerate into areas
rbulent flow. These spots erupt independently near the trailing
of the turbulent-flow region which is always moving downstream.
addition of the newly turbulent areas of finite size to the trai-
face of the turbulent-flow region causes it to jump upstream
ntinuously. Spots are travelling at a very low velocity when they
become visible and accelerate to continue downstream at a
city of about 0.7 times free-stream speed at their trailing face.
origin of the fresh areas of breakdown to turbulence is appa-
ly in amplified Tollmien—Schlichting waves. The frequency of spot production lies within the region where stability theory predicts that disturbances within the boundary layer will be amplified. It is concluded that transition mechanisms in supersonic flow are similar to those in a subsonic air stream.

533.6

16728 STAGNATION POINT FLUCTUATIONS ON A BODY OF REVOLUTION.

A.M.Kuethe, W.W.Willmarth and G.H.Crocker.
Phys. of Fluids, Vol. 2, No. 6, 714-16 (Nov.-Dec., 1959).

The bodies chosen had hemispherical noses with diameters 2in., 11.7 in., and 20 in., with fineness ratios 17, 6.3 and 5.2 respectively. Measurements were made in a wind tunnel at Reynolds numbers from 5×10^4 to 2×10^6 and hot wire measurements outside the boundary layer showed that the stagnation point fluctuated in position in both subsonic tests and in tests with a Mach number of 2.44. Most of the turbulent energy is in the range 0 - 5 c/s, probably due to vorticity fluctuations. Instability due to three dimensional disturbances would not cause the observed effects; a possible cause is the stretching of vortex filaments.

N.Corcoran

533.6

16729 APPLICATION OF A PROPERTY OF SUPERSONIC FLOW TO THE DESIGN OF A PNEUMATIC PIVOT.

R.Comolet and J.Sapaly.
C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3769-70 (June 8, 1960).
In French.

In air lubricated bearings the speed of air may be supersonic and give rise to local lowering of the pressure. The resulting suction is regarded as unfavourable; it can, however, be utilised for stabilising the axis of rotation in a central position. A brief description of a rotor is added which runs smoothly at 1000 revolutions per second.

R.Eisenschitz

GASEOUS STATE

533.7

16730 APPARATUS DRAWINGS PROJECT. REPORT NUMBER 9. SIMPLE KINETIC THEORY DEMONSTRATION. R.G.Marcley.

Amer. J. Phys., Vol. 28, No. 7, 666-9 (Oct., 1960).

The apparatus described in this article is a model for the simple kinetic theory of an ideal gas. It dramatically demonstrates the concept that the pressure a gas exerts on the walls of its container is due to the combined effect of the many individual impacts of the gas molecules on those walls. A massive moving system integrates the effect of many small equal impulses to produce a steady deflection whose magnitude is accurately predicted by simple theory.

533.7 : 537.56

16731 THE "TWO-FLUID" MODEL IN THE CLASSICAL KINETIC THEORY OF GASES. P.Glansdorff.

Physica, Vol. 25, No. 10, 988-1000 (Oct., 1959). In French.

The conditions are studied under which the classical model of diffusion is no longer suitable for explaining the dynamical behaviour of gaseous mixtures and has to be replaced by a "two fluid" model of the type used for helium II at very low temperatures. It is shown that such conditions, although exceptional, can nevertheless exist in certain ionized plasma for high kinetic temperatures of the electrons. Their effects in rapidly varying macroscopic phenomena are considered.

533.7 : 532.7

APPROXIMATIONS IN THE THEORY OF DENSE FLUIDS. See Abstr. 16686

533.7

16732 MASS SPECTRA OF ALUMINUM (III) HALIDES AND THE HEATS OF DISSOCIATION OF Al_2F_6(g) AND $LiF.AlF_3$(g).

R.F.Porter and E.E.Zeller.
J. chem. Phys., Vol. 33, No. 3, 858-63 (Sept., 1960).

Mass spectra of gaseous aluminium (III) chloride and bromide were obtained and interpreted quatitatively in terms of the degree of association in the vapour phase. Ion currents indicative of a molecular trimer of $AlCl_3$ were observed. Mass spectra of the vapours effusing from a Knudsen cell containing AlF_3 were obtained and the stability of the molecular dimer of AlF_3(g) was determined quantitatively. Mass spectra of vapours from LiF-AlF_3 mixtures indicate the existence of a stable $LiF.AlF_3$ (g) molecule. Ion current data were obtained as a function of condensed phase composition. A second complex molecular species which appears to be either $(LiF)_2.AlF_3(g)$ or $(LiF.AlF_3)_2(g)$ was observed. For the reaction $Al_2F_6(g) = 2AlF_3(g)$, $\Delta H^\circ_{1000} = 48.0 \pm 4.0$ kcal/mole dimer, and for $LiF.AlF_3(g) = LiF(g) + AlF_3(g)$, $\Delta H^\circ_{1000} = 73 \pm 4$ kcal/mole.

533.7

16733

EXPERIMENTAL DETERMINATION OF THE EQUATIONS OF STATE OF ARGON UP TO 1000°C AND 1000 kg/cm².

A.Lecocq.
J. Rech. Cent. Nat. Rech. Sci., No. 50, 55-82 (March, 1960).
In French.

Experimental procedure is given in fair detail, with adequate diagrams. Results comprise 12 series of measurements at densities and temperatures ranging from 13-250 amagats and 300-1000°C. Six isotherms are given in tabular form. The first three virial coefficients are given in tables and compared with data from other sources, and with predictions based on rigid sphere, square well, Lennard-Jones 6-α and Buckingham 6-exp models of interatomic potentials. It is concluded that the range of data is insufficient for a distinction to be made between the models. P.Gray

533.7

16734

THE EQUATION OF STATE OF THE HYDROGEN ISOTOPES AND THEIR MIXTURES WITH HELIUM BELOW THE BOILING POINT OF HYDROGEN.

F.H.Varekamp and J.J.M.Beenakker.
Physica, Vol. 25, No. 10, 889-904 (Oct., 1959).

A method is described for measuring the temperature dependence of the second virial coefficient of the hydrogen isotopes relative to helium gas. The accuracy of this method is approximately a factor of ten higher than can be reached by standard p, V measurements. The results for H_2, HD and D_2 and their mixtures with helium are given as a function of temperature below the boiling point of hydrogen. For numerical analysis empirical expressions for the data of the pure components are given.

533.7

16735

TRANSPORT PROPERTIES FOR GASES ASSUMING INVERSE POWER INTERMOLECULAR POTENTIALS.

T.Kihara, M.H.Taylor and J.O.Hirschfelder.
Phys. of Fluids, Vol. 3, No. 5, 715-20 (Sept.-Oct., 1960).

The integrals required for the calculation of transport properties for gases are carefully examined, assuming that the intermolecular potentials vary inversely as a power of the separation, $\Phi = -c/r^n$. When the potential corresponds to mutual attraction, the behaviour at the origin, corresponding to the centres of the two molecules colliding, must be prescribed because some trajectories of the relative motion reach the origin. Calculations are made on the basis of three models: (a) A rigid core corresponding to the Sutherland potential in the limit that the rigid core approaches zero (for spherical models this is the most realistic model); (b) a transparent core model which corresponds to the limiting behaviour of a well-shaped potential; and (c) a random-scattering core model which is an appropriate idealization for molecules without spherical symmetry. The behaviour of the collision integrals is considered for the full range of potentials as n goes from one to infinity (or from the Coulomb to the rigid-sphere potential).

533.7 : 539.17

DIFFUSION PHENOMENA AND ISOTOPE EFFECTS IN THE EXTRACTION OF FISSION-PRODUCT XENON AND KRYPTON FROM IRRADIATED U_3O_8. See Abstr. 15620

533.7 : 532.7

16736

ON THE PARTICLE SIZE SPECTRUM OF A CONDENSING VAPOR. S.K.Friedlander.

Phys. of Fluids, Vol. 3, No. 5, 693-6 (Sept.-Oct., 1960).

The classical theories of condensation and coagulation are considered as limiting cases of a general theory of new phase formation. By making several assumptions concerning the nature of the vapour and of the cooling process, it is shown that the equation of condensation can be written in a simplified dimensionless form. The embryo size spectrum function at the end of the condensation process is a function of a number of dimensionless groups; hence, condensation can be modeled in the sense that particle size can be controlled by varying certain scale factors. An application to condensation by mixing of a hot vapour with cool air is proposed.

533.7 : 5

16737

SOUND ABSORPTION IN NITROGEN AND OXYGEN.

H.D.Parbrook and W.Tempest.
Acustica, Vol. 8, No. 6, 345-50 (1958).

The published values for sound absorption in nitrogen and oxygen are examined and further values up to 44 (Mc/s) atm^{-1} a reported. The simple hypothesis of a single time constant rotat relaxation in no way correlates the absorption and velocity measurements.

533.7 : 53

16738

VAPOUR PRESSURE OF NITROGEN AND HYDROGE AT LOW PRESSURES.

E.S.Borovik, S.F.Grishin and E.Ya.Grishina.
Zh. tekh. Fiz., Vol. 30, No. 5, 539-45 (May, 1960). In Russian.

The method used (described and illustrated in detail) consist mainly in that the tested gas is condensed on a cooled surface in high vacuum. After some time a pressure is produced in the fre space above the surface, at which the rate of condensation equals the rate of evaporation (sublimation) of the tested substance; any error caused by the presence of impurities with a higher vapour pressure is counteracted by continuous pumping (the equilibrium virtually unaffected by it, if the pumping rate is very small comp with the evaporation rate of the basic substance). The values obt for H_2 (vapour pressures between 3.4 and 4.5°K) yield a heat of sublimation L = 248 cal mole^{-1}, which agrees well with experime values of the heats of evaporation and of melting. Values are als obtained for N_2 between 21.2 and 26.4°K. The extreme vacua attainable with He and H_2 condensation pumps are calculated. Th method enables saturated vapour pressures to be measured down 10^{-9}--10^{-10} mm Hg. F.Lach

533.7 : 538.27 : 53

ENHANCEMENT OF NUCLEAR POLARIZATION IN LIQUIDS AND GASES ADSORBED ON CARBON. EXTENSION TO SOLIDS CONTAINING PARAMAGNETIC IMPURITIES. See Abstr. 16717

533.7 : 538.27 : 53

N.M.R. SPECTRA OF ORGANIC GASES. See Abstr. 16712

VACUUM PHYSICS

53

16739

A METAL APPARATUS FOR EXPERIMENTS IN ULTRA-HIGH VACUUM. H.Ehlers and J.Moll.

Z. angew. Phys., Vol. 12, No. 7, 324-8 (July, 1960). In German.

The ultra-high vacuum vessel was a thin-walled chamber (bakable up to 450°C) surrounded by a separately pumped bell jar system maintained at 10^{-5} – 10^{-6} torr. The main system was evacuated by an oil diffusion pump with water-cooled and liquid nitrogen-cooled baffles obtaining 10^{-8} torr in 3-4 hr and an ultima pressure of 3×10^{-9} torr. The double vacuum system allowed th use of bakable demountable knife-edge copper sealing rings for windows, rotary seals and current lead-throughs having a tightnes of the order 10^{-4} – 10^{-3} torr litre/sec. The deposition of clean th films of metals evaporated at pressures below 10^{-8} torr is briefly discussed. W.Steckelmach

533.5

16740

PUMP FLUIDS FOR HIGH VACUUMS.

K.Hickman.
Nature (London), Vol. 187, 405-6 (July 30, 1960).

A class of phenoxy benzenes and polyphenyl ethers characterized by very low vapour pressures (at 25° C) were investigated as pumping fluids in an untrapped, three-stage, glass, air-cooled, vapour pump and gave ultimate pressures indicated on an untrappe Bayard–Alpert ionization gauge in the range 10^{-8} – 10^{-10} torr. Fo example, m-bis(m-phenoxyphenoxy)-benzene with an extrapolated vapour pressure of 10^{-12} torr (at 25° C) gave an untrapped lowest ultimate pressure of 4.5×10^{-10} torr. W.Steckelmache

533

16741

A HIGH-CAPACITY VACUUM ADSORPTION PUMP.

B.G.Lazarev and M.F.Fedorova.
Zh. tekh. Fiz., Vol. 30, No. 7, 865-7 (July, 1960). In Russian.

The pump described and illustrated in some detail, operates two other pumps (first a fore pump, then a diffusion pump) charge of activated charcoal cooled with liquid nitrogen. The ity of the adsorption pump varies from 250-300 l./sec at mm Hg to 3000 l./sec at p = 10^{-3} mm Hg. With the char- harge of about 1000 g, and a gas leakage of about 1 cm^3/hour, mp is capable of maintaining a vacuum of p = 10^{-6} mm Hg or or about 3 months. (See also Abstr. 8721 of 1960).

F.Lachman

533.5

742 PUMPING CHARACTERISTICS OF A TITANIUM DROPLET GETTER-ION PUMP.

lland and L.Laurenson.

J. appl. Phys., Vol. 11, No. 9, 401-7 (Sept., 1960).

The performance has been studied of a 12 in. diameter titanium r-ion pump with an evaporated-getter area of 3400 cm^2. The um was evaporated from an electron-bombarded molten bead ended via a frozen zone from a cooled anode; a triode electrode m was used for ionization pumping. The sorption rates of a er of gases were measured in the pressure range 10^{-4}-10^{-8} mm ercury. The pumping speed for nitrogen was enhanced by ting the ionization source during evaporation. The h.t. voltage with the vapour source influenced the form of the titanium bead, t low voltages (approximately 800 V) and high power inputs oximately 465 W) large metal droplets were obtained giving the st evaporation and sorption rates. Sorption rates were greatly ased if a diffusion pump was in operation during gettering, se impurity gases slowly sorbed by the getter-ion pump were effectively removed. Pumping speeds in $l.s^{-1}$ at 10^{-6} mm of ury for the getter-ion pump with a diffusion pump (10 $l.s^{-1}$) in tion and a titanium evaporation rate of 40 mg/min were as vs: oxygen$_2$—2450; nitrogen$_2$—4500; hydrogen$_2$—1600; air—600; —2.5; Calor gas—90. The low pumping speed of air was due low sorption rate of the argon component. Hydrocarbon gases slowly sorbed and when mixed with active gases greatly ed their pumping speed. The pump-down characteristics of etter-ion pump were examined and it was found that the ultimate ure was only slowly regained after exhausting oxygen. The ion efficiency can be found from the equation: $S_m = \alpha S_0$, where the measured sorption rate per unit getter area ($l.s^{-1} cm^{-2}$) S_0 is eal sorption rate and α the sorption coefficient. Values of α ured at 10^{-6} mm of mercury were as follows: oxygen$_2$—0.068; gen$_2$—0.12; hydrogen$_2$—0.012; possible reasons for the low value or hydrogen are considered.

533.5

743 INSULATED TERMINALS FOR HIGH-VACUUM SYSTEMS USING DEMOUNTABLE GLASS-METAL

S. R.S.Nelson.

. Instrum., Vol. 37, No. 9, 358-9 (Sept., 1960).

he design described uses either an indium (non-bakable) or nium (bakable) gasket which is compressed between the metal ope of the vacuum apparatus and the Pyrex glass insulator to the vacuum seal.

A.H.W.Beck

533.5

744 A THERMOELECTRIC HIGH-VACUUM TRAP FOR THE N-5 PUMP.

olenko, A.G.Tauber, V.G.Yur'ev and A.G.Shcherbina.

verdogo Tela, Sbornik [Supplement] I, 282-4 (1959). In Russian.

escribes a cold trap for vacuum work, consisting of a water- thermopile which reduces temperature to −50° C at the expendi- f 90 W and 120 litres/hour of water.

A.Tybulewicz

533.5

745 TRAPPING WITH ALUMINA IN VACUUM SYSTEMS AND ITS EFFECT ON CATHODE ACTIVITY.

arris.

sci. Instrum., Vol. 31, No. 8, 903-4 (Aug., 1960).

n experimental comparison of a conventional liquid-nitrogen and a non-refrigerated alumina trap was carried out. Both were employed in a high-vacuum system used to pump a test ; the saturated emission from the oxide-coated cathode in the was used as a measure of the success of the traps in keeping minants from the tube. The alumina trap was found to prevent isoning effects so often observed when oil diffusion pumps are with conventional trapping systems.

C.H.B.Mee

533.5

746 SORPTION AND DESORPTION OF GAS IN A HOT-CATHODE IONIZATION GAUGE.

aker and T.A.Giorgi.

J. appl. Phys., Vol. 11, No. 9, 433-6 (Sept., 1960).

n omegatron has been used to analyse continuously the gases present during sorption/desorption experiments with a hot-cathode ionization gauge. It is shown that the most abundant residual gas at the termination of ion sorption pumping is carbon monoxide. Ten per cent or less of the total gas originally sorbed is readily recovered at an exponential rate, indicating that this fraction of the gas is held at solid surfaces rather than within the solids themselves. It is also found that the fraction of gas that is readily recovered diminishes with successive pumping and recovery according to the relation $(i_+)^2_{max} \propto 1/t$, where t is the time recorded from initial operation of the experimental gauge and $(i_+)_{max}$ is the positive ion current corresponding to the maximum pressure attained during recovery.

533.5

16747 SURFACE CLEANING BY CATHODE SPUTTERING.

O.C.Yonts and D.E.Harrison, Jr.

J. appl. Phys., Vol. 31, No. 9, 1583-4 (Sept., 1960).

Evidence is presented to indicate that surface recontamination from background gases may be a significant factor in quantitative sputtering measurements, even for beam current densities of 0.1 mA/cm^2 and operating pressures of 5×10^{-5} mm of Hg. An over-simplified mechanism is discussed which leads to criteria for a clean-surface sputtering experiment.

533.5

16748 PRE-BREAKDOWN CONDUCTION IN CONTINUOUSLY-PUMPED VACUUM SYSTEMS.

W.K.Mansfield.

Brit. J. appl. Phys., Vol. 11, No. 10, 454-61 (Oct., 1960).

Measurements have been made under impulse conditions of the coefficients A', the number of H^+ ions emitted per 250 keV H^- ion, and B', the number of H^- ions emitted per 250 keV H^+ ion, for metal surfaces covered with the contaminating layers likely to be formed in continuously-pumped high voltage apparatus. The values obtained for A' were 1.0, 1.1 and 0.54, and for B' 0.43, 0.24 and 0.44 for copper, aluminium and steel targets respectively. The product of these coefficients is such as to make very probably the hypothesis that pulse discharge conduction in these systems is due to the regenerative exchange of positive and negative ions of hydrogen. The transient nature of this form of conduction is thought to be due to the charging up of the insulating contaminant.

VIBRATIONS · ACOUSTICS

534.1

16749 STRESS AND STRAIN LIMITS ON THE ATTAINABLE VELOCITY IN MECHANICAL VIBRATION.

F.V.Hunt.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1123-8 (Sept., 1960).

The maximum peak velocity which can be developed at the free end of a slender rod driven at resonance in a normal mode of longitudinal vibration is given by $v_0 = c_0 S_{xx}$, where c_0 is the Young's-modulus speed of sound $(E/\rho)^{1/2}$ and S_{xx} is the limiting value of extensional strain for the rod material. The ratio of allowable stress to the maximum peak velocity is given by $T_{xx}/v_0 = \rho c_0$, where the characteristic specific impedance plays in this case the role of a transfer impedance relating the stress at a node to the velocity at an antinode. The same expressions describe, within half an order of magnitude, the relations between the maximum allowable stress or strain and the normal component of velocity at the antinodes of displacement for thin uniform bars or plates and for wedges or cones vibrating in flexure, and for an exponential solid horn vibrating longitudinally. By inductive extension it is argued that within the indicated precision the same velocity-strain ratios prevail in the vibration of any elastic body however excited.

534.11

16750 EXTENSION OF KAR FORMULA FOR MINIMUM BOWING PRESSURE.

K.C.Kar and C.Dutta.

Indian J. theor. Phys., Vol. 5, No. 2, 31-7 (June, 1957).

Kar formula for minimum bowing pressure (Abstr. 2497 of 1955) is extended for low velocity of bowing. The formula thus obtained satisfactorily explains both the straight portion at high velocities and the upward bend at low velocities of the P_{min} versus V curve. It is also shown that the frictional forces due to bowing are same during forward and backward motion of the string.

534.12 : 621.372.412

16751 CONTOUR VIBRATIONS OF SQUARE THIN QUARTZ PLATES. A.Tachibana.

J. Inst. Elect. Commun. Engrs Japan, Vol. 43, No. 4, 573-9 (April, 1960). In Japanese.

An equation for the frequencies of the contour modes of vibration of square thin anisotropic plates has been given by Bechmann (See Abstr. 4965 of 1952). Experimental results are here given for the frequency constants of quartz plates whose two flat surfaces are parallel to the X axis. The specimens tested were $Y_{\theta,0^\circ}$, $Y38^\circ,\phi$, $Y90^\circ,\phi$ and $Y_{128^\circ,\phi}$ cut plates, the values of θ ranging from 0° to 180° and those of ϕ from 0° to 45°. The results for 3 longitudinal modes and one shear mode are shown graphically, together with the values calculated from Bechmann's equation, the agreement between the experimental and calculated values being, in general, very good. Higher-order contour vibrations of $Y_{\theta,0^\circ}$ cut plates are also discussed.

A.Wilkinson

534.12

16752 NOTE ON SOME PROBLEMS OF THIN EQUILATERAL TRIANGULAR PLATE. B.Sen.

Indian J. theor. Phys., Vol. 5, No. 3, 77-9 (Sept., 1957).

Trilinear coordinates are used to solve some problems of vibrations of a thin equilateral triangular plate with supported edges.

534.13

16753 FORCED BENDING AND EXTENSIONAL VIBRATIONS OF A TWO-LAYER COMPOUND LINEAR VISCO-ELASTIC BEAM. F.Schwarzl.

Acustica, Vol. 8, No. 3, 164-72 (1958).

In the forced vibrations of a two-layer viscoelastic beam four basic cases are to be distinguished: (1) a pure tensile vibration excited by a tensile force and a bending moment; (2) a pure bending vibration excited by a bending moment and a tensile force; (3) a superposition of a bending vibration and a longitudinal vibration under a pure bending moment; (4) a superposition of a longitudinal vibration and a bending vibration under a pure tensile force. The apparent stiffness against bending or tension, the damping and the energy dissipation in these four cases are discussed as functions of the elastic constants and the ratio of the layers.

534.13

16754 VIBRATIONS OF BEAMS LOADED DISCONTINUOUSLY. Y.Jullien.

Acustica, Vol. 8, No. 4, 201-11 (1958). In French.

The transverse vibrations of beams resting on an elastic foundation and loaded discontinuously are studied. The load is expressed as a Fourier series and the problem reduced to a differential equation with a periodic coefficient. By means of a fictitious extension and the introduction of a suitable fictitious loading, a periodic solution is obtained and the coefficients determined by comparison with those in the differential equation. Several examples are given: free beam, fixed beam, guided and fixed beam. The natural frequencies and positions of nodes as observed agree satisfactorily with theory.

534.13

16755 DAMPING OF ELASTICALLY MOUNTED BEAMS. W.Kuhl and F.K.Schröder.

Akust. Beihefte [Acustica], No. 1, 79-84 (1956). In German.

Calculations have been made of the sound insulation when sound is transmitted through a spring element to the free end of a beam of infinite length and to a beam infinite on both sides respectively and, futhermore, of the effect of a loading mass fixed to the beam at the excitation point. To some extent comparison is made with results of laboratory experiments and practical applications. In the systems described above a bending wave is excited on the beam by the lateral force transmitted by the spring element. The influence on the level difference of wave propagation in the coupling element and of its losses has been studied on steel and rubber springs. The properties of springs important for applications are discussed.

534.13

16756 FAMILY OF BARS OF REVOLUTION IN LONGITUDINAL HALF-WAVE RESONANCE. F.J.Young.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1263-4 (Oct., 1960).

Expressions for the velocity potential, velocity transformation ratio, node location, resonant length, stresses, and mechanical impedances are derived for a family of tapered bars of revolution in longitudinal half-wave resonance.

16757 EQUIVALENT LINEARIZATION OF THE HARD SPRING OSCILLATOR. R.H.Lyon.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1161 (Sept., 1960).

The technique of "equivalent linearization" is applied to th
problem of random vibration of a hard spring oscillator. Since
exact solution of this problem is available, it is possible to ded
the effciency with which the approximate technique estimates s
parameters as frequency of zero crossings and moments. It is
found that second and fourth moments are estimated rather wel
the average frequency may be substantially in error.

534.13 : 539.2 :

THE OSCILLATIONS OF DIELECTRIC BODIES. See Abst

See Abstr. 16030

16758 MODELS FOR ACOUSTIC LOSS IN SOLIDS. L.Knopoff and G.J.F.MacDonald.

J. geophys. Res., Vol. 65, No. 7, 2191-7 (July, 1960).

A macroscopic model for the attenuation of small-amplitu
stress waves in solids is presented. The loss mechanism desc
is that of solid friction which varies as the gradient of the local
stress. The model is illustrated by a mass-spring system slid
a rough surface in which the roughness of the surface increases
either direction with distance from the equilibrium position of t
mass. The Q for the model is independent of frequency. Expe
mental evidence for the dependence of Q on surface area in sil
aggregates suggests the validity of a solid-friction model.

5

16759 ON DISTURBANCES GENERATED BY A PULSE OF PRESSURE ON THE SURFACE OF A SPHERICAL CAVITY IN AN ELASTIC MEDIUM. S.K.Chakraborty.

Indian J. theor. Phys., Vol. 6, No. 3, 85-9 (Sept., 1958).

The propagation of disturbances in an elastic infinite mediu
is considered when the disturbance is produced by a sinusoidal
pulse of pressure applied on the surface of a spherical cavity in
medium.

5

16760 PROPAGATION OF A PRESSURE PULSE IN A COMPRESSIBLE FLOW—CODA. A.Powell.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1116 (Sept., 1960).

As explained previously (Abstr. 131 of 1960) the disturbanc
due to an initially step-like pressure wave progressing down a
channel carrying a compressible flow can be analysed by a mult
reflection method. For the final "transmitted" and "reflected"
pressures, this yields a power series expansion, successive ter
representing the effect of higher order reflections. It is now sh
that the coefficients of these series are connected to Euler's an
Bernoulli's numbers, respectively, and convenient expressions
the coefficients are given. When n is not small, the coefficient
$c^n \cong 2(2/\pi)^{n+1}$. The infinite power series are shown to have s
simply like sech x and tanh x, respectively. This provides an e
means of numerical evaluation, and gives simple criteria for th
accuracy of the approach using the leading term of each of the s
The results when reflections of all orders are taken into accoun
shown to be analytically identical to those of the "before" and "
steady flow method.

53

16761 MEASUREMENT OF SOUND TRANSMISSION THRO AN ORIFICE IN A DUCT WITH AN APPLICATION T A RESONATOR. W.K.R.Lippert.

Acustica, Vol 8, No. 3, 173-8 (1958).

Magnitude and phase values of both the reflected and trans-
mitted (plane) sound waves at an orifice in a brass plate termin
by a square input duct and a nonreflecting output duct were care
measured at numerous frequencies and at an intensity level at w
linearity is valid. A resonator was formed by terminating a port
the output duct with a brass piston, and a formula for the reflect
of sound from this resonator is derived and proved to be valid b
experiments.

53

16762 CHARACTERISTIC PARAMETERS OF PROPAGATI IN LINED DUCTS. R.S.Piazza.

Acustica, Vol. 9, No. 3, 129-34 (1959).

A method is described for the determination of characteris
parameters of sound propagation in a duct lined with absorbing
material; the duct is considered as an acoustic line with distrib

ieters (Sivian's monodimensional theory). The method is d to a circular duct with four different lining materials; the imental values demonstrate the existence of a series resistance the theory does not consider. The resistance in series affects ably the value of the attenuation constant.

534.22

763 USE OF A VELOCITY—POTENTIAL FUNCTION IN SOLVING THE WAVE EQUATION FOR VISCOUS
A. M.Bentwich.
oust. Soc. Amer., Vol. 32, No. 8, 1080 (Aug., 1960).

t is shown that though the wave equations for viscous and non-us media are similar, the use of a potential function is not 's permissible in the viscous case. Statements made by Mintzer anenbaum (Abstr. 1000 of 1960) are analysed accordingly.

534.22

6764 ON THE VELOCITY OF SOUND AND THE SECOND VIRIAL COEFFICIENT IN O_2. V.Hovi and R.Näsänen.
Acad. Sci. Fennicae, A VI, No. 35, 6 pp. (1959).

Values for the velocity of sound at different temperatures have calculated for O_2. These values were compared with the experi-al data appearing in Abstr. 5438 of 1959. The agreement was to be good. The numerical solution of a differential equation ecting the velocity of sound and the second viral coefficient was ined. It was shown that one can obtain for $\partial B/\partial T$ and for B the differential equation presented in this investigation at least ignificant number.

534.22

6765 AN APPARATUS FOR MEASURING AND RECORDING THE VELOCITY OF SOUND AND TEMPERATURE
SUS DEPTH IN SEA WATER. A.Lutsch.
tica, Vol. 8, No. 6, 387-91 (1958).

Two crystals are placed opposite each other at a fixed distance ter. The first crystal transmits a short ultrasonic pulse. This is received by the second crystal. The generation of the l)th pulse is triggered by the nth received pulse. The resulting ition frequency is automatically recorded. Multiple reflections e water path are avoided by impedance matching at the backs of rystals. The carrier frequency is 1 Mc/s, the relative accuracy 03‰. Also the temperature can be recorded by means of a nistor bridge. The records were made on an X—Y recorder in the X coordinate is the depth, measured by a pressure gauge bridge, while the Y coordinate is alternatively the velocity of l or the temperature. Values were recorded to depths up to . The response time is a few seconds.

534.22

6766 DETERMINATION OF ULTRASONIC VELOCITIES BY MEASUREMENT OF ANGLES OF TOTAL REFLECTION.
Mayer.
oust. Soc. Amer., Vol. 32, No. 10, 1213-15 (Oct., 1960).

A simple method, based on the total reflection of a sound beam a liquid—solid boundary at the critical angles, is described. this method, it is possible to measure the velocity of longitud-nd shear waves in the solid by locating the angles of maximum ction in the liquid.

534.22

6767 A VARIABLE FREQUENCY INTERFEROMETER FOR MEASUREMENT OF ULTRASONIC VELOCITIES IN
IDS. B.Ramachandra Rao and K.Subbarao.
tica, Vol. 8, No. 1, 63-4 (1958).

A two crystal interferometer is described. It was calibrated distilled water at frequencies remote from the fundamental nance of the crystals (1.1 Mc/s). The velocities measured in ganic liquids are lower than those found by other methods by 6.6%.
H.D.Parbrook

534.22 : 536.65

768 A RELATION BETWEEN ULTRA-SONIC VELOCITY AND LATENT HEAT OF VAPORIZATION.
Rao and P.R.K.L.Padmini.
re (London), Vol. 187, 311-12 (July 23, 1960).

The ultrasonic velocity data taken from the literature for forty-five liquids and some measurements made on liquids ncluded in the literature are analysed. It is shown that the wing empirical relation can be obtained: $L_v = 133\ V^2$ where L_v e latent heat of vaporization in cal/g and V is the ultra-velocity in km /sec. Significant variations from the relation found only in the case of highly associating liquids like water, ols and organic acids. A theoretical deduction of the relation be published shortly.
C.F.Barnaby

534.22 : 541.13 : 532.7

16769 ULTRASONIC VELOCITIES IN AQUEOUS ELECTROLYTE SOLUTIONS. C.G.Balachandran.
Nature (London), Vol. 187, 136-7 (July 9, 1960).

Reports an investigation of the variation of ultrasonic velocities in a number of aqueous electrolyte solutions with concentration and temperature. Several electrolytes showed the unusual behaviour of decreasing sound velocity with increasing concentration and it was found that the velocity decrease was always associated with the presence of heavy ions, indicating a possible correlation between the two factors. General conclusions reached from detailed studies of the behaviour of ultrasonic velocities in electrolytes are listed.
B.Brown

534.22 : 531.78

PIEZOELECTRIC PRESSURE GAUGES FOR USE IN A SHOCK TUBE. See Abstr. 16665

534.22

16770 ON THE BOLTZMANN EQUATION AND THE STRUCTURE OF SHOCK WAVES. W.A.Gustafson.
Phys. of Fluids, Vol. 3, No. 5, 732-4 (Sept.-Oct., 1960).

The methods of Mott-Smith (Abstr. 6801 of 1951) and Rosen (Abstr. 4086 of 1954) for the shock structure problem are correlated. It is found that the application of Rosen's restricted variational technique to the Boltzmann equation yields the transport equation used by Mott-Smith, and in addition determines a transport function. The expression for the average translational temperature profile, as derived by Mott-Smith, is examined for the existence of relative minima or maxima. For a monatomic gas the temperature profiles have no relative extrema inside the shock wave for any Mach number. For a diatomic gas the temperature profiles are smooth for Mach numbers below 1.89, but above that a hump appears.

534.22

16771 DENSITY COMPRESSION RATIO ACROSS RELATIVISTIC-STRONG-SHOCK WAVES. A.W.Guess.
Phys. of Fluids, Vol. 3, No. 5, 697-705 (Sept.-Oct., 1960).

The relativistic Rankine—Hugoniot shock wave conditions of Taub are extended to include radiation pressure and energy density. Specialization to the situation of a nonrelativistic ambient gas gives strong shocks, and solutions are obtained separately for the cases of a pure material gas and a pure radiation gas behind the shock. The material gas is considered to have a constant adiabatic exponent $\gamma \leq 2$, or to be itself relativistic, and the value $\gamma = \frac{4}{3}$ gives the radiation gas results. The rest density compression increases above its nonrelativistic strong shock limit $(\gamma + 1)/(\gamma - 1)$, by a term proportional to β^2 in the lowest order, where β is the ratio of shock velocity to light velocity. As $\beta \to 1$ (extreme relativistic strong shock) the rest density compression goes as $1/(1 - \beta^2)^{1/2}$, but there is no setting-in of degeneracy in the shocked gas. In shock coordinates, the flow velocity ratio across the shock (front to back) decreases monotonically from its nonrelativistic limit and approaches the value $1/(\gamma - 1)$ as $\beta \to 1$. An expression is also obtained for the velocity of relativistic sound wave propagation in a mixture of a thermally perfect material gas and a radiation gas.

534.22 : 541.12

16772 ON THE STRUCTURE OF PLANE DETONATION WAVES. T.C.Adamson, Jr.
Phys. of Fluids, Vol. 3, No. 5, 706-14 (Sept.-Oct., 1960).

A steady planar detonation wave, considered to be a shock wave followed by a reaction zone, is studied with both irreversible and reversible first-order reaction kinetics. A perturbation solution with first-order transport effects, valid in the reaction zone for those cases where the ratio of the characteristic chemical time is small compared to one, is presented with sample calculations of temperature distributions for typical irreversible and reversible reaction cases. Analysis of the solution shows that simple series solutions and hence the given perturbation solutions do not hold near the hot boundary for all possible final Mach numbers. In the irreversible reaction case, the perturbation solution is a valid approximation for final Mach numbers less than $(1 - B)^{1/2}$, where B is the ratio of characteristic times, the approximation becoming less accurate as the Mach numbers tend toward this limiting value. In the reversible reaction case, the perturbation solution is a valid approximation for final Mach numbers up to the Chapman—Jouguet value of unity, if the Mach number is based on the equilibrium speed of sound.

534.22

16773 VERTICALLY TRAVELING SHOCK WAVES IN THE IONOSPHERE. F.B.Daniels, S.J.Bauer and A.K.Harris.

J. geophys. Res., Vol. 65, No. 6, 1848-50 (June, 1960).

Atomic explosions have provided a means of studying hydromagnetic phenomena and the results have shown that two waves are propagated, the retarded sound wave and one, or a combination, of the other two hydromagnetic modes. The velocity of the faster wave confirms the view that the density of the whole gas rather than that of the ions alone should be used in computing the velocities of hydromagnetic waves. J.M.Hough

534.22

16774 THICKNESS OF SHOCK FRONTS IN ARGON. K.Hansen and D.F.Hornig.

J. chem. Phys., Vol. 33, No. 3, 913-16 (Sept., 1960).

The accuracy and sensitivity of the optical reflectivity method for determining the thickness of shock fronts have been improved. The thickness of shock fronts in argon were measured up to $M = 2.38$. Most of the effort was concentrated at $M = 2.38$ where the reciprocal thickness in mean free paths, $l_0/L_0 = 0.234 \pm 0.007$. At $M = 2.38$ the front is $\sim 20\%$ thicker than calculated from the Navier-Stokes equations but the thickness agrees very closely with that calculated by Muckenfuss using a bimodal distribution function.

534.22 : 539.19

LUMINOSITY OF SHOCK WAVES IN XENON. See Abstr. 15728

534.22 : 621.396.946

16775 THEORY OF EQUILIBRIUM ELECTRON AND PARTICLE DENSITIES BEHIND NORMAL AND OBLIQUE HYPERSONIC SHOCK WAVES IN AIR.

C.A.Roberts, W.B.Sisco and J.M.Fiskin.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 1, 102-3 (Jan., 1960).

The quantitative changes in propagation, aerial impedance, radar cross-section, breakdown, and emissivity characteristics resulting from hypersonic plasmas depend on the electrons and heavier particles present. To determine these number densities for normal and oblique shocks, aerothermodynamic theory is applied to relate macroscopic properties on both sides of the shock front by means of the flow conservation equations. Composition and energy of the shocked air at assumed velocities, densities, and temperatures are then obtained using the law of mass action and the principles of statistical quantum mechanics until the conservation equations are satisfied.

534.22

16776 MEASUREMENT OF THE SHOCK ADIABATIC CURVES OF CAST TROTYL, CRYSTALLINE HEXOGENE AND NITROMETHANE.

V.S.Ilyukhin, P.F.Pokhil, O.K.Rozanov and N.S.Shvedova.

Dokl. Akad. Nauk SSSR, Vol. 131, No. 4, 793-6 (April 1, 1960). In Russian.

The reflection method (Al'tshuler, Krupnikov and Brazhnik, Abstr. 7573 of 1958) was used. The apparatus used is illustrated and described in detail. Empirical relationships between the shock-wave velocity and the mass velocity were established from the results obtained, and so were the curves showing the dependence of the pressure behind the shock-wave front on the relative specific volume. F.Lachman

534.23

16777 IN ANSWER TO A.A.TUZHILIN'S LETTER TO THE EDITOR. A.A.Senkevich.

Akust. Zh., Vol. 5, No. 3, 381-2 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 391-2 (Feb., 1960).

Defends the original paper (Abstr. 6764 of 1958), dealing with the waveform of an acoustic radiator, against the criticism of Tuzhilin (Abstr. 5464 of 1959), by stating that the results obtained were only approximate and cannot be compared with the exact hydrodynamic solution. S.Chomet

534.23

16778 IN ANSWER TO A.A.SENKEVICH. A.A.Tuzhilin.

Akust. Zh., Vol. 5, No. 3, 383 (1959). In Russian. English translation in: Soviet Physics—Acoustics (New York), Vol. 5, No. 3, 393 (Feb., 1960).

See preceding abstract. Reiterates the original criticism (Abstr. 5464 of 1959) by stating that the effects associated with the finite amplitude of the radiator had already been more adequat treated when Senkevich's paper (Abstr. 6764 of 1958) was publis S.Ch

53

16779 PNEUMATIC GENERATORS OF INTENSE ULTRASOUND. V.Gavreau.

Acustica, Vol. 8, No. 3, 121-30 (1958). In French.

Toroidal whistles derived from the police whistle are desc Their operation at low pressure is discussed: oscillation of the jet produced by the emitted sound, conditions to obtain high effi (30%) and pure sinusoidal tone without harmonics; and at high pr ure: oscillations produced by the air jet returning to strike at t base, edge sound superposed on the other components of the emi complex sound. The equation of whistles and calculation of thei theoretical efficiency are given. Contradiction between the theo horns and the experimental results: no cut-off frequency. Prac calculation of annular exponential horns for emission of plane wa Advantages and disadvantages of whistles and of ultrasonic sire Applications are described.

53

16780 UNDERWATER EDGE TONES. M.J.Gross.

Acustica, Vol. 9, No. 3, 164-72 (1959).

For a test of alternative theories of the mechanism of edge tone production, data are obtained on a slit-jet-edge system set under water. Photographs of the form of the jet are taken in a schlieren system and the frequencies of the tones measured by a hot-wire anemometer and oscillograph. Comparison is made wi earlier results obtained in air and all are discussed from the po of view of a feedback theory.

53

16781 SOUND SOURCE NEAR A VELOCITY DISCONTINUIT P.Gottlieb.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1117-22 (Sept., 1960).

The far-field solution for a line and a point source near a tangential velocity discontinuity has been calculated by summing (integrating) the plane waves that make up the source. The exact field integrals were evaluated approximately by the stationary-ph method, and this approximation gives the far field. It was found that the sound was strongly peaked in some directions, and consi ably reduced in others. This angular dependence is shown graph for certain cases. The physical significance of these results is discussed for both subsonic and supersonic motions, and the rela ship to the jet-noise problem is suggested.

53

16782 ENERGY FLUX FROM AN ACOUSTIC SOURCE CONTAINED IN A MOVING FLUID ELEMENT AND I RELATION TO JET NOISE. H.S.Ribner.

J. Acoust. Soc. Amer., Vol. 32, No. 9, 1159-60 (Sept., 1960).

It is found that a high-frequency source (or multipole) imbed in a moving patch of fluid emits a constant acoustic power indepe of the motion. (The directivity is, however, altered). This holds when the wavelength $\lambda \ll$ radius R' of the entire region of flow. the other extreme $\lambda \gg 2\pi R'$: it appears that the acoustic power i enhanced by the motion, somewhat (but not exactly) as the emissi of a source is enhanced by motion through fluid at rest. A typica wavelength of a radiating eddy in a jet lies between the two extre and a limited convective enhancement of the power is inferred. T amount should be less than that predicted by Lighthill (Abstr. 337 of 1952; 3188 of 1954) or the much more conservative values sug by the work of Ribner (Abstr. 7897 of 1959); it could conceivably lie within experimental error, justifying the nonconvective law, power $\sim U^8$, found by measurement.

534

16783 A CONVENIENT CLASSIFICATION OF THE ELECTR MECHANICAL TRANSDUCER WITH REGARD TO ITS DESIGN AND ITS ELECTRICAL AND MECHANICAL CHARACTE ISTICS. A.Lenk.

Acustica, Vol. 8, No. 3, 159-63 (1958). In German.

A systematic classification is given for the electromechanica transducer, which differs in several points from that commonly given. A very simple criterion for allotting such a transducer to one of four groups is given which depends only on simple properti of the construction. Each group is then classified into an equival circuit, the elements of which can be derived from the constructi of the transducer.

534.23 : 621.317.39 : 621.372.5

784 THE DUALITY OF THE FOUR-TERMINAL NETWORK EQUATIONS OF ELECTROMECHANICAL TRANS- RS AND THEIR ELECTRICAL FOUR-TERMINAL EQUIVA- CIRCUITS. J.Kacprowski.

ica, Vol. 8, No. 6, 379-86 (1958). In German.

ttention is drawn to the lack of uniqueness in the two-pole as s four-pole theory of passive linear electromechanical lucers as regards their four-pole equations and corresponding alent circuits. The reason given for this is the duality of the omechanical coupling factor. It is shown that the choice of a le coupling factor as well as of four-pole equations and sponding equivalent circuits depends on determined polarization ding conditions of the transducer concerned. Two possible pole equations and their two corresponding circuits holding for assive and linear (linearized) electromechanical transducer iven. Attention is drawn to the fact that in the case of parallel ear electric and magnetic transducers working in improper ization or loading conditions the additional stiffness caused by eaction of the electric or magnetic field is positive.

534.23

785 INVESTIGATION ON THE EFFECT OF EIGEN-RESONANCES OF THE MEASURING CHAMBER ON RESULTS OF SOUND ABSORPTION MEASUREMENTS.

ckl and K.Seifert.

tica, Vol. 8, No. 4, 212-20 (1958). In German.

Theoretical and experimental investigations of sound insulation rms of a one-dimensional model showed the influence of eigen- nances of the measuring chamber on the results. In particular ound insulation between identical large rooms is too low in tice. Theoretical considerations of three-dimensional rooms that with a small and a large room for sending and receiving ectively, the insulation deduced from the usual formula depends e direction of the sound, but the results do not contradict the procity principle.

534.23

16786 MEASUREMENT OF ACOUSTIC IMPEDANCE IN A RESONANT SPHERICAL ENCLOSURE.

Ferrero and G.G.Sacerdote.

tica, Vol. 8, No. 5, 325-9 (1958).

From measurements of the resonant frequency and the decay tant in the first radial mode of vibration of a spherical osure containing a concentric sphere of absorbent material, it ssible to obtain the acoustic impedance of this material. The rimental apparatus described may be used for measurements of dance of samples in various gases under different conditions of sure and temperature.

534.23

6787 CALCULATION OF THE STATISTICAL ABSORPTION COEFFICIENT FROM ACOUSTIC IMPEDANCE TUBE SUREMENTS. P.Dubout and W.Davern.

tica, Vol. 9, No. 1, 15-16 (1959).

Data have been calculated and a chart drawn enabling the stical absorption coefficient to be deduced directly from surements made with the acoustic impedance tube.

534.23 : 533.7

SOUND ABSORPTION IN NITROGEN AND OXYGEN. See r. 16737

534.23

6788 INTERFEROMETRIC SOUND ABSORPTION MEASUREMENT IN CO_2. J.Schreiner.

tica, Vol. 9, No. 3, 144-50 (1959). In German.

A method of calculating absorption at 287.85 kc/s in CO_2 using mpedance interferometer with any given circuit relationships ars to afford greater precision than the usual methods. If ter interferometer paths are used, it appears that the size of ransducer has small influence on the results. Measurements e so-called interference field are hardly distorted by the action and can be used for absorption measurements. In dry the measured coefficient $\mu = 2\alpha\lambda = 0.0611 \pm 0.0007$, in agree- with theory and the published results.

534.23

16789 SOUND ABSORPTION OF POROUS FOAMED PLASTICS. G.Venzke.

tica, Vol. 8, No. 5, 295-300 (1958). In German.

The frequency-dependence of the absorption coefficient for perpendicular and diffuse incidence is investigated. By comparison with the theory for a porous substance with a rigid skeleton, the foamed plastic appears to have a greater structure factor than most fibrous mats. It is shown how the elasticity of the skeleton and the provision of a skin-covering or perforations affect the frequency-dependence of the absorption.

534.23

16790 PULSE TECHNIQUES FOR MEASURING ULTRASONIC ABSORPTION IN LIQUIDS.

J.H.Andreae, R.Bass, E.L.Heasell and J.Lamb.

Acustica, Vol. 8, No. 3, 131-42 (1958).

Describes the construction and operation of equipment for the measurement of the ultrasonic absorption in liquids by the pulse method over a range of frequencies from 1 to 200 Mc/s. General considerations on the design of experimental systems are discussed together with the practical limitations. Details are given of the electrical and mechanical parts of three systems which are in current use, and permit the measurement of ultrasonic absorption within an accuracy of ±2%. The first two systems, A and B, are designed to operate up to a frequency of 200 Mc/s and illustrate alternative lines of approach to the problem. The third system C can be used for measurements on liquids under pressures up to 100 atm. It incorporates a common transmitter-detector system and provides a longer ultrasonic path than do the first two systems: thus smaller absorption coefficients can be measured or measurements made at correspondingly lower frequencies, down to a minimum of 1 Mc/s. Attenuation measurements are referred to various piston attenuators which have been constructed and checked against each other.

534.23

16791 ULTRASONIC ABSORPTION IN BONES. T.Kishimoto.

Acustica, Vol. 8, No. 3, 179-80 (1958).

This was measured in the range 1.43 to 4.5 Mc/s using a pulse method. The absorption was proportional to frequency and the temperature coefficient was less than that for artificial high polymers. The absorption may therefore result from a hysteresis type loss. H.D.Parbrook

534.24

16792 THE TOTAL REFLECTION OF WAVES IN MOVING MEDIA. A.Metz.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3792-4 (June 8, 1960). In French.

Previous papers (Abstr. 11916 of 1959; 14741 of 1960) have shown that sound waves or ultrasonic waves propagated in media undergo refraction and total reflection not only when they pass from one medium to another where the speed of propagation is different, but also when the media are moving relative to one another. General formulae relating to these phenomena were given previously and the present paper derives a more exact formula relating to the propagation of waves under such conditions. Formulae derived in previous papers are used without detailed explanation. B.Brown

534.26 : 538.56

DIFFRACTION OF AN ARBITRARY PULSE BY A WEDGE OR A CONE. See Abstr. 15144

534.4

16793 A PHOTOGRAPHIC METHOD FOR THE MEASUREMENT OF STATIONARY SOUND-PRESSURE-FIELDS.

H.Jablonska.

Acustica, Vol. 8, No. 1, 63 (1958). In German.

Brief reference is made to the use of a microphone with an associated glow lamp to explore the sound field in front of loudspeakers. The brightness of the lamp is used to indicate the variations of pressure in the sound field. Illustrations of the interference fields in front of two loudspeakers and the sound field with phase variations in front of a small loudspeaker, are given. A.B.Wood

534.4

16794 TREATMENT OF THE EXCITATION AND PERTURBATION PROBLEMS IN ACOUSTIC RESONATORS. W.Pechhold.

Acustica, Vol. 9, No. 1, 48-56 (1959). In German.

Problems relating to the excitation and perturbation of resonators, of which the spectrum of complex characteristics is known, can be solved by an integral theorem of continuum mechanics without tedious calculations. This method is illustrated in the case of simple natural frequencies of resonators in the form of circular cylinders but can be applied to more complicated forms of vibration.

534.6

16795 THE ACOUSTICS DEPARTMENT OF THE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (P.T.B.), BRUNSWICK. M.Grützmacher.
Akust. Beihefte[Acustica], No. 1, 224-7 (1956). In German.

534.6

16796 CRITERION AND NEW METHOD OF CLASSIFICATION FOR SYMMETRICAL FILTERS WITH LOSSES.
W.K.R.Lippert.
Acustica, Vol. 8, No. 5, 337-41 (1958).

A phase criterion for the characteristic reflection and transmission factors of passive and symmetrical acoustical filters with losses is derived from general energy considerations. The criterion consists of a specific restriction for possible phase differences of those factors, if the sum of the magnitude values is greater than unity. The phase criterion is represented in a diagram and is shown to be useful for classifying symmetrical filters in a new way.

534.6

16797 MEASUREMENT OF ULTRASONIC INTENSITY WITH THE HOT WIRE. J.Schreiner.
Acustica, Vol. 8, No. 5, 303-7 (1958). In German.

A survey of the literature shows that the relations between sound intensity and the non-periodic change of resistance of a preheated wire due to cooling are not completely understood. In order to make use of the hot-wire in absorption measurements with an ultrasonic interferometer, calibration measurements were carried out at 287.75 kc/s in dry carbon dioxide. As a measure of the sound intensity the electric input power of the quartz transmitter was determined by directly measuring current, voltage and phase with the help of a cathode ray oscilloscope. Over the range of lower intensities — broad enough for experimental purposes — a linear relation between the sound intensity and the change of voltage at the hot-wire was found. It is, however, proved that this simple relationship makes the hot-wire unsuited to measure the sound absorption with the interferometer. At higher intensities no simple relationship was found.

534.6 : 550.8

16798 ULTRASONIC METHOD FOR THE EXPLORATION OF THE PROPERTIES AND STRUCTURE OF MINERAL LAYERS. W.Koltoński and I.Malecki.
Acustica, Vol. 8, No. 5, 307-14 (1958).

The method is based on the same principle as hydrolocation and ultrasonic flaw detection of metals using frequencies from 50 to 300 kc/s. The attenuation and velocity of wave as well as the location of the inhomogeneities of the medium is determined on the basis of the amplitude, shape and transit time of the direct or reflected pulse. The experimental material (collected in the salt mines and quarries) proves that the conditions of ultrasonic propagation in rocks are exceedingly more complicated and subject to changes than in metals or water, but the range and accuracy of measurement are quite sufficient for practical purposes. The measurements use the damping and velocity of ultrasonic waves in different rocky media. Various tests have also been carried out on detecting different types of inhomogeneity in layers of salt and rocks. General relations between the parameters of ultrasonic propagation in those media and their structure, physico-chemical properties and types of discontinuity are determined.

534.6

16799 MEASUREMENTS OF LOUD SPEAKERS IN THEIR OPERATING POSITIONS. T.S.Korn and J.Hougardy.
Acustica, Vol. 9, No. 3, 121-6 (1959). In French.

The properties of loud-speaker arrays have a tendency to be influenced by the auditorium. Free-field tests of such apparatus therefore are perhaps unreliable unless the apparatus is to work in the open air, for example. A study is made of the influence of the room on the sound transducer, for which the motional impedance rises when it is moved from the middle to the corner of the room: hence the idea of "room amplification".

534.6 : 621.317.39

16800 A TUNED CAPACITIVE DETECTOR FOR HIGH FREQUENCY VIBRATIONS. P.G.Bordoni and M.Nuovo.
Acustica, Vol. 8, No. 6, 351-62 (1958).

A new apparatus for studying the longitudinal vibrations of plates in the megacycle range has been developed using an electrostatic drive and detector. The mechanical vibrations are converted to an a.c. signal by means of a d.c. polarizing voltage applied to the probe as is normally done for electrostatic microphones. The detection circuit is tuned on the vibration frequency; in this wa high sensitivity has been obtained. Detailed information is give the circuitry and on upper frequency limits for the application apparatus in the measurement of the mechanical properties of Experimental data are given on the longitudinal sound velocity on the damping of various plates and on their dependence on ten ture.

5

16801 EXPERIMENTAL STUDY OF VARIOUS TYPES OF STOPPED SOUNDING PIPE, FROM THE POINT OF VIEW OF THE PURITY OF THE TIMBRE. R.Tanner.
Acustica, Vol. 8, No. 4, 226-36 (1958). In French.

By means of three complementary methods (auditory, acous and electro-acoustic) an experimental study was made of the pu of quality of various diapason types of sounding pipe, all having same frequency but built on different theoretical principles whi should affect the quality. Best results were obtained with a dou stopped pipe with a rectangular-cut aperture.

5

16802 INVESTIGATION ON THE VIBRATION PROPERTIE OF THE VIOLIN. L.Suominen.
Acustica, Vol. 8, No. 6, 363-70 (1958). In German.

The possibility of tuning violins in different frequency rang discussed in relation to experiments which show that the spectr a violin is determined by resonances in its parts. The qualities violins of the old masters are illustrated with the help of the sp and the observed forms of vibration. The conclusions agree wit tuning methods of the old masters. The object of this work is to how to give a determined tone quality to a violin by varying the mass—spring relationships; also to find in what way the wooden plates should vibrate to give the optimal waveform in different frequency ranges, and in which range violins of normal size and shape should be tuned.

53

16803 SOUND PRESSURE SPECTRA OF A MUTED CORNE J.E.Ancell.
J. Acoust. Soc. Amer., Vol. 32, No. 9, 1101-4 (Sept., 1960).

Acoustic spectra of a cornet have been measured with the instrument equipped with several mutes of types used mainly in dance orchestras. Data are presented showing the sound pressu levels of the first 10-15 partials of the instrument when fitted w each of the mutes. The instrument was blown naturally by a cor tist, with an attempt to obtain a normal characteristic tone for e mute. The sound spectrum of the muted instrument is compared that of the open or unmuted instrument. The mutes tend to exhib the same formants for several different notes, indicating resona phenomena in the acoustic networks. The measurements were m by playing the instrument in a dead room, and recording the sour tape, with a condenser microphone and a magnetic tape recorder professional quality. The sounds were then analysed by playback through a heterodyne wave analyser. Two of the mutes, the Har and the Solotone, are equipped with cylindrical aluminium tubes open at both ends. The formants for these mutes display familie of resonance peaks corresponding to the calculated open pipe frequencies. These resonances are also observed when the mute are driven with an electroacoustic transducer. All of the mutes themselves act as Helmholtz resonators at 200 to 300 c/s, which however, in the frequency range of considerably reduced output when fitted to the instrument.

53

16804 SOUND DEADENERS TESTING. C.B.Sacerdote.
Akust. Beihefte [Acustica], No. 1, 174-9 (1956).

Results of measurements on the properties of deadeners of sound are reported. The influence of the position of the supports on a vibrating system have been particularly studied, and measu ments have been made to determine the relation between the para meters of two materials, forced to vibrate together.

53

16805 RESONANT ABSORBING METALLIC STRUCTURES. M.A.Ferrero and G.G.Sacerdote.
Acustica, Vol. 9, No. 1, 23-6 (1959).

The characteristic parameters of an absorbing resonant structure, constituted by an iron sheet punched with circular ori covering an air space, are measured. The variation of the equiv resistance with the incident sound pressure is shown.

534.83

306 NOISE CHARACTERISTICS OF HELICOPTER ROTORS AT TIP SPEEDS UP TO 900 FEET PER SECOND.
ibbard and D.J.Maglieri.
ust. Soc. Amer., Vol. 32, No. 9, 1105-7 (Sept., 1960).

vidence is presented which suggests that the noise of full-scale pter rotors results mainly from conditions of unsteady flow. rements of the sound-pressure levels and spectra are present- r test conditions where gear train, engine, and other propulsion n noises are minimized. These data cover a range of tip- s from 100 ft/sec to 900 ft/sec for various rotor disk loadings. s indicate that both tip-speed and disk loading have an import- luence on the noise radiated from the rotor. During stall, the -pressure levels increased at all frequencies, but particularly high end of the spectrum. As a matter of special interest, a -peaked wave form due to possible Doppler effects was noted ssociated with high tip-speed operation.

534.84

307 A SEMI-EMPIRICAL METHOD OF CALCULATING REVERBERATION CHAMBER COEFFICIENTS FROM STIC IMPEDANCE VALUES. B.S.Atal.
ca, Vol. 9, No. 1, 27-30 (1959).

semi-empirical method is described which enables the ation of the absorption coefficient which would be measured everberation chamber from the specific acoustic impedance red by the impedance tube. The reverberation chamber ients have been calculated by this method for nine commercial ials at five standard frequencies using the acoustic impedance given by Beranek (1940). In the method proposed the acoustic ance measured by the impedance tube is multiplied by a suitably complex quantity to obtain a modified impedance. This mul- g factor is the same for all materials considered here and s only upon the frequency. The absorption coefficient in a erant field is then obtained from this modified impedance by raging procedure similar to that used by Paris (1927). The thus calculated agree with the A.M.A. values to within ±0.06 cases except two.

534.84

308 OPTICAL ANALOGUE OF STATIONARY DIFFUSIVITY IN REVERBERATING ROOMS. H.Kuttruff.
ca, Vol. 8, No. 5, 330-6 (1958). In German.

he dependence of the diffusity of a stationary sound field in a on the geometry and the reflective properties of the walls was d for the case of very high frequencies with an optical analogue. a directional photocell the directional diffusity was measured endence on the ground plan, the position of the light source and flective properties of the walls. It follows that in order to e high directional diffusity with specularly reflecting walls t departure from the rectangular form could be an advantage, at it is a disadvantage to locate the source in a corner or s. The best results were obtained with irregularly reflecting in this case no considerable influence of the form of the room ound. If a part of the wall area was absorbing, a simple on between the size of the absorbing area and the directional ity was only given if the rest of the walls were reflecting larly.

534.84

309 THE RADIATION BEHAVIOUR OF PLATES.
K.Gösele.
. Beihefte [Acustica], No. 1, 94-8 (1956). In German.

: is found by theoretical considerations that normal radiation iour of plates occurs for $\lambda_B > \lambda_L$ and abnormally small radia- or $\lambda_B < \lambda_L$. In the first case the behaviour of a plate excited xural waves is almost equivalent to a vibrating piston and, ever the dimensions of the plate exceed λ_B, neither the internal ing nor the dimensions have any influence in this case. In the of abnormal radiation however, these parameters, primarily mensions of the plate, are of great importance. The decrease liation amounts to 10-20 dB. The calculation from the vibration tudes of the walls and ceilings of the sound radiated into air is possible for thick walls with a low limiting frequency, but ilties arise in the case of thin walls because there sometimes a mixture of free and forced vibrations with different wave s for a given frequency.

534.84

16810 FLUCTUATIONS OF THE SOUND PRESSURE LEVEL IN ROOMS WHEN THE RECEIVER POSITION IS VARIED. P.E.Doak.
Acustica, Vol. 9, No. 1, 1-9 (1959).

A theoretical description is given of the fluctuations in sound pressure level in rooms when the receiver position is varied, and these are confirmed by experiments. Fluctuations are insensitive to wall shape. Far from the source and for frequencies satisfying Schröder's "large room" condition r.m.s. deviation of the pressure level from its average value is the same for variation in the source or receiver position as it is for variation of the source frequency, namely, 5.5 dB. Near to the source, or at lower frequencies, the size and shape of a typical fluctuation depend upon the source radiation characteristic, the reverberation time, the room volume and the type of eigenfunctions (axial, tangential or transverse) predominant among those with eigenfrequencies near the driving frequency.

534.84

16811 MEASUREMENT OF [ACOUSTIC] DIFFUSION AND APPLICATION TO THE ACOUSTICS OF ROOMS.
R.Lamoral.
Acustica, Vol. 9, No. 1, 57-60 (1959). In French.

The irregularities in the level at a fixed frequency in a room were measured with a rotating microphone using a special electronic counter. A preliminary test with polycylinders in a model room excited ultrasonically showed the zone of action of the polycylinders. In full-scale tests in the actual room, the presence of the diffusers produced an anomaly in the curve of irregularities as a function of frequency, in agreement with the results on the model.

534.84 : 621.396.97

16812 DIFFUSION OF SOUND IN SMALL ROOMS.
K.E.Randall and F.L.Ward.
Proc. Instn Elect. Engrs, Paper 3272 E, publ. Sept., 1960 (Vol. 107B, 439-50).

Describes an investigation of some problems of sound diffusion in rooms, with particular reference to small sound and television studios. The experimental work shows that it is possible to measure the degree of diffusion in a room by fairly simple practical techniques. Quantities based on the frequency variation of reverberation time and double reverberation decay constants are the most promising for use in small broadcasting studios. It is also shown that uniform distribution of absorption can be as effective as other means of attaining conditions of good diffusion. Rectangular diffusers are particularly effective in improving conditions where the distribution of absorption is poor.

534.84

16813 ARCHITECTURAL ACOUSTICS OF CHURCHES OF VARIOUS PERIODS OF ARCHITECTURAL STYLES.
G.Venzke.
Acustica, Vol. 9, No. 3, 151-4 (1959). In German.

The acoustical properties of certain churches, selected in regard to style and date as typical of the periods (Romanesque, Gothic, Renaissance, Baroque, Modern) are compared and the frequency dependence of their reverberation times discussed.

GEOMETRICAL AND INSTRUMENTAL OPTICS
SPECTROSCOPY

(Optical spectra and their analysis are included under the appropriate heading, e.g. Atoms, Molecules, Solid-State Physics, etc.)

535.3

16814 THE TOTAL REFLECTION WAVE.
P.Acloque and C.Guillemet.
C.R.Acad. Sci. (Paris), Vol. 250, No. 26, 4328-30 (June 27, 1960). In French.

Three experiments are described to show that, at total reflection, light enters the second medium. This light travels along the surface and can be refracted back into the first medium. A number of possible uses of this phenomenon are suggested. R.W.Fish

535.31

16815 SOME PROBLEMS OF THE GEOMETRICAL OPTICS OF TOROIDAL SURFACES. J.Casas and J.Barcala.

Atti Fond. Ronchi, Vol. 15, No. 3, 289-313 (May-June, 1960). In Italian.

An experimental arrangement is described whereby theoretical predictions were tested photographically. An appendix contains derivations of some lens characteristics in terms of power series.

R.A.Weale

535.31

16816 RONCHI TEST CHARTS FOR PARABOLIC MIRRORS. A.A.Sherwood.

Atti Fond. Ronchi, Vol. 15, No. 4, 340-6 (July-Aug., 1960).

Deals with the preparation of a series of test charts giving the shape of the Ronchi shadow band patterns for testing parabolic mirrors for a wide range of aperture ratios. The method of application of the results to specific cases is discussed.

535.31

16817 FOUR-COLOR ACHROMATS AND SUPERCHROMATS. R.E.Stephens.

J. Opt. Soc. Amer., Vol. 50, No. 10, 1016-19 (Oct., 1960).

Materials suitable for the construction of achromatic lenses corrected for four wavelengths are selected by the use of three graphs which are the three orthographic projections of a three-dimensional graph in P, Q, and V, where $V = (n_d - 1)/(n_F - n_C)$, $P = (n_h - n_C)/(n_F - n_C)$, and $Q = (n_{1.014} - n_C)/(n_F - n_C)$. One set of three glasses, Schott PKS-1, F-1, and KzFS-4, has been selected, from which a four-color achromat has been designed. Analysis at 12 wavelengths shows this design to have negligible residual chromatic aberration. It is consequently a superchromat in accordance with Herzberger's prediction.

535.31

16818 STUDY AND CONSTRUCTION OF A CORRECTION SYSTEM FOR RESIDUAL ABERRATIONS OF A WIDE-APERTURE SPHERICAL MIRROR. J.Pouleau.

Rev. Opt., Vol. 37, No. 12, 577-97 (Dec., 1958). In French.

This is a study of various wide-aperture optical devices incorporating spherical concave mirrors and correcting elements. A new system based on the Schmidt plate principle is discussed and compared to objectives of known types, the system being considered both from the point of view of correction performance and of simplicity of manufacture. Correction of spherical aberration of mirrors is obtained by using a set of two complementary aspherical plates cemented together, the refractive indexes being somewhat different. The major merit of the system is, as calculation shows, that plate cutting accuracy requirements depend only upon the difference between the respective indexes of the two plates. Assuming a difference in the order of 5×10^{-3}, the accuracy requirement is approximately 0.03 mm, a degree of precision that can be easily achieved by purely mechanical means, without final correction. With Schmidt plates of conventional type, the accuracy requirement would have been 0.2 μ. Another advantage of this system is that achromatic plates can be obtained by using materials of identical or near-identical dispersion values for the two plates.

535.31

16819 RESPONSE OF ASTIGMATIC OPTICAL SYSTEMS. B.K.Nath.

J. Assoc. Appl. Physicists, Vol. 5, 74-82 (1958).

An analytic expression for response of astigmatic optical systems has been developed and utilized to obtain: (a) the nature of variation of response to line structures having different orientations, (b) the best focal plane in the presence of curvature such that the variation of response over the entire image plane is minimum, and (c) optimum balancing of and tolerances on the aberration coefficients in the presence of higher order astigmatism.

535.32

16820 MEASUREMENT OF THE REFRACTIVE INDICES OF GASES IN THE INFRARED USING A MICHELSON INTERFEROMETER. F.Legay and P.Barchewitz.

J. Phys. Radium, Vol. 19, No. 3, 433-4 (March, 1958). In French.

A Michelson interferometer, coupled with a grating spectrograph, is used in the infrared, from 1 to 5 μ, to measure refractive indices of gases. The device was specially designed for dispersion measurements near vibration—rotation lines. Different methods have been used: (1) Absolute index measurements, at a fixed wavelength, by varying the pressure in the gas-chamber. (2) Dispersion measurements by channeled spectrum method, at a given pressure. (3) Measurement of index ratio, by recording the beats in the f arising from two different grating orders. Without any pressu temperature measurement, the ratio may be measured with hig accuracy. The effect of the resolving power is briefly discuss typical measurements on HCl and air are given. Accuracy is improved by using the rotation of a compensator plate to meas fractional orders.

5

16821 REFRACTIVE DISPERSION OF NITROGEN IN THE VACUUM ULTRAVIOLET. P.G.Wilkinson.

J. Opt. Soc. Amer., Vol. 50, No. 10, 1102-5 (Oct., 1960).

The refractive dispersion of nitrogen has been measured f the first time in the 1649 A to 2042 A region by means of a high dispersion vacuum spectrograph. The data fit the following equ to ±0.13%:

$$n - 1 = \frac{6.3622 \times 10^4}{45.989 \times 10^8 - \nu^2} + \frac{32.453 \times 10^8}{1065.11 \times 10^8 - \nu^2}.$$

The resonance frequencies and oscillator strengths obtained fr this equation have no real significance because the data are too inaccurate and were obtained at wavelengths much longer than t nearest allowed transition. Improved measurements at shorter wavelengths would be desirable.

16822 APLANATIC LENSES OF HIGH REFRACTIVE INDE A.K.Head.

J. Opt. Soc. Amer., Vol. 50, No. 9, 922 (Sept., 1960).

Gives shapes and maximum apertures of aplanatic singlet lenses with n = 2.4 and 4.0 and one infinite conjugate. W.T.We

5

16823 DEFECTOCONOSCOPE DEVICES FOR STUDYING OPTICAL ANOMALIES IN CRYSTALS AND DETERM ING THE ORIENTATION OF WATCH JEWELS.

S.V.Grum-Grzhimailo.

Kristallografiya, Vol. 4, No. 3, 431-3 (May-June, 1959). In Russ English translation in: Soviet Physics—Crystallography (New Y Vol. 4, No. 3, 405-8 (March, 1960).

A microscope for revealing conoscopic patterns in micro-crystal plates and components is described. Optical axial angle can be measured. The apparatus is used for examination of bire fringent anomalies in crystalline watch jewels, and localization stresses.

S.Tola

5

16824 MULTIFILTER METHOD FOR DETERMINING RELATIVE SPECTRAL SENSITIVITY FUNCTIONS O PHOTOELECTRIC DETECTORS. G.Wyszecki.

J. Opt. Soc. Amer., Vol. 50, No. 10, 992-8 (Oct., 1960).

Experimental difficulties encountered in the determination o spectral sensitivity functions (S_λ) of photoelectric detectors mak desirable to have independent checks on a measured S_λ. A multi filter method is described which allows not only a check on a giv S_λ, but also makes it possible to determine S_λ directly and indep dently of any previous measurements. The filters employed in th method have to satisfy the condition that their spectral transmitt functions form a set of linearly independent functions over the sp tral range considered. The practical importance of the method a ways of checking its precision are discussed, using a numerical example which involves 14 linearly independent filters forming a 14 × 14 matrix of spectral transmittances for the spectral range 390 to 670 mμ.

53

16825 TRANSMISSION OF "CUTOFF" GLASS FILTERS EMPLOYED IN SOLAR RADIATION RESEARCH. II.

A.K.Ångström and A.J.Drummond.

J. Opt. Soc. Amer., Vol. 50, No. 10, 974-9 (Oct., 1960).

For Pt. I see Abstr. 13172 of 1959. An investigation into the transmission characteristics of coloured glass filters. Special attention is paid to the determination of the absorption coefficien in the main transmission regions of Schott OG1, RG2, and RG8 filt through the employment of substantial thicknesses of glass. Thi study embraces also an investigation of the temperature depende of the absorption coefficients.

5

16826 THE IMAGE OF THICK OBJECTS IN THE PHASE-CONTRAST MICROSCOPE.

R.Grigorovici and R.Manaila.

Rev. Opt., Vol. 37, No. 6, 281-90 (June, 1958). In French.

Phase-contrast studies are reported on the colours of thin

of ammonium chloride (0.4 to 3 μ thick). The colours of 32
.s of different thicknesses are studied colorimetrically.
s agree with theoretical prediction as long as the crystal
ss does not appreciably exceed the depth of focus of the
cope. The colorometric theory is worked out in detail.

S.Tolansky

535.8

27 FURTHER STUDY ON THE DIFFRACTION IMAGES IN THE POLARIZING MICROSCOPE.

ta and H.Saito.

Soc. Amer., Vol. 50, No. 10, 1020-4 (Oct., 1960).

r earlier work, see Abstr. 5601 of 1959. Response function
olarizing microscope is given, whose amplitude of the diffrac-
age is

$$A(r,\theta) = \sin 2\theta \cdot J_3(2\pi ar/\lambda l)/(2\pi ar/\lambda l),$$

r, θ are the polar coordinates in the image plane. Calculation
ade using the fact that the autocorrelation function of the
nction is the response function. Comparison of the result
e experiment (photograph of the Siemens' star) is made,
g a good agreement. The diffraction image of the polarizing
scope is also studied when a z-cut uniaxial crystal is inserted
aperture is so large that the first and the second inter-
e fringes in the conoscopic image are in view. Results are
mpared with the photograph of the diffraction image.

535.8

8 APPLICATION OF THE INTERFERENCE MICROSCOPE MII-4 TO THE STUDY OF CRYSTAL SURFACES.

endelev.

lografiya, Vol. 4, No. 3, 429-31 (May-June, 1959). In Russian.
translation in: Soviet Physics—Crystallography (New York),
No. 3, 403-5 (March, 1960).

brief description is given of a two-beam interference micro-
suitable for examining the microtopographies of crystals.

S.Tolansky

535.8

29 A REFLECTOMETER, BASED ON A $CaSO_4$:Mn PHOSPHOR, FOR USE IN THE VACUUM ULTRAVIOLET

N. V.A.Arkhangel'skaya, B.I.Vainberg and T.K.Razumova.

i Spektrosk., Vol. 8, No. 2, 279-80 (Feb., 1960). In Russian.

escribes a simple reflectometer based on the ability of
Mn to store energy when irradiated with ultraviolet light of
ngths $\lambda \leq 1500$ A and to liberate this energy in the form of
heating (thermoluminescence). The magnitude of the stored
(the light-sum) depends linearly on the intensity of ultra-
radiation and its duration within a wide range of the latter
ies. The instrument was used to measure the reflection
ient of aluminized and Pd-coated mirrors, of glass and fused
between 120 and 145 mμ; these reflection coefficients agreed
ith the values obtained by means of a vacuum spectrometer.
strument is recommended for rapid measurement of the
ion coefficients in mass production of mirrors and diffraction
gs for the ultraviolet region. Together with LiF, CaF_2 and
lters the instrument can be used to measure the transmission
ient of optical materials at 122, 127 and 140 mμ.

A.Tybulewicz

535.8 : 537.312

30 GaAs, A SENSITIVE PHOTODIODE FOR THE VISIBLE.

G.Lucovsky and P.H.Cholet.

. Soc. Amer., Vol. 50, No. 10, 979-83 (Oct., 1960).

ighly sensitive photodiodes have been formed in n-type GaAs
usion of Cd and Zn. The photodiodes display a peak mono-
atic sensitivity of 6×10^{-13} W$(c/s)^{-1/2}$ at 8500 A and have
ensitivity points at 9100 and 5600 A. The dynamic impedance
e detectors is in the order of one megohm and their time
nt, which is determined by the dynamic impedance and junc-
pacity, is the order of 1 msec. Noise measurements in the
00 c/s region show no evidence of any 1/f component. Pre-
ry experiments indicate that these photodiodes are equally
ive when operated in the back biased or photoconductive mode.
tectors operate at room temperature and do not require
ulation. Several detectors have been successfully immersed
sapphire optics. The optical transparency of GaAs in the 1-
region enables the detector to be used in front of a suitable
tector, e.g., InAs, in "two-colour" detection systems. The
ivity of this detector is found to compare favourably with a
ercial photomultiplier.

535.8 : 621.383 : 621.396.933

16831 OPTICAL DESIGN FOR INFRARED MISSILE-SEEKERS.

H.Dubner.

Proc. Inst. Radio Engrs, Vol. 47, No. 9, 1537-9 (Sept., 1959).

Various designs are described, and their faults discussed. The final design adopted uses a dome of Corning 0160 glass, a concave primary mirror, a plane secondary mirror and an arsenic trisulphide correcting lens. The system has no primary spherical aberration, no coma, no astigmatism, no field curvature, and little chromatic aberration.

C.Hilsum

535.33

16832 A CONTRIBUTION TO THE THEORY OF THE MULTIPLEX INTERFEROMETRIC SPECTROMETER.

P.Fellgett.

J. Phys. Radium, Vol. 19, No. 3, 187-91 (March, 1958). In French.

Instruments for spectral analysis may be separated into two classes, typified by the spectrograph and spectrometer, according to whether the elements of the spectrum are measured simultaneously or successively. In a spectrograph the whole spectrum is recorded simultaneously. In a spectrometer, the spectrum is measured by scanning the slit so that spectral elements are measured one at a time. If N spectral elements are resolved in a total observation time of T, then the exposure time for each element is T for a spectrograph, but only T/N for a spectrometer. This is equivalent to a factor of $N^{1/2}$ in sensitivity in favour of the spectrograph. This difficulty can be overcome by multiplexing a single detector; that is, by impressing mutually orthogonal modulation patterns on the spectral elements. This can be done by interference. The radiation to be analysed is divided into two beams which are then re-combined with path difference x so that they interfere. The intensity due to one spectral element then goes through one sinusoidal cycle for a change in x equal to the wavelength λ of the element, so that the total intensity produced by the interference contains sinusoidal components of different frequency due to the different spectral elements. The orthogonal properties of sine functions enable these components to be separated and thus the intensity distribution in the spectrum of the radiation can be measured.

535.33

16833 INTERFEROMETRIC MODULATION AND AN ANALOGUE COMPUTER FOR AN INTERFEROMETRIC SPECTROMETER.

J.D.Strong and G.Vanasse.

J. Phys. Radium, Vol. 19, No. 3, 192-6 (March, 1958). In French.

A review of the work at Johns Hopkins University, Baltimore involving interferometric modulation for visible and far infrared spectroscopy. Also, a progress report is given on an analogue computer that transforms bolometric data directly into spectral intensities. A new interferometer is briefly described.

535.33

16834 SOME EXPERIMENTAL FOURIER METHODS FOR EXAMINING THE FORM OF SPECTRAL LINES.

E.Ingelstam.

J. Phys. Radium, Vol. 19, No. 3, 209-14 (March, 1958). In French.

The possibilities of using one-dimensional phase contrast interference techniques for obtaining the spectral transform $E(\sigma)$ of a light source are discussed and apparatus outlined. Some factors of merit are lower than for other techniques, but the procedures are simple. They seem to be attractive for obtaining additional information of a partially known spectrum, such as broadening of lines, etc... Designs are outlined for use in the infrared. Attention is drawn to the techniques now extensively used for examining incoherent imaging (frequency response functions) which may be used with advantage in spectral apparatus for examining fine-structure, Zeeman spectra etc...

535.33

16835 AN INTERFEROMETRIC SPECTROMETER FOR SELECTING BY AMPLITUDE MODULATION.

P.Connes.

J. Phys. Radium, Vol. 19, No. 3, 215-22 (March, 1958). In French.

A new spectrometric method, chiefly useful in the infrared is described. By replacing the mirrors of a Michelson interferometer by two gratings with equal incidence and varying the path difference between the two beams in a linear way, one is able to modulate in a complex spectrum a single element whose width is equal to the theoretical resolution limit of the grating. The solid angle of the admissible beam is much greater than in a classical spectrometer, thus this method gives an important increase in luminous flux. The instrument is described together with the first experimental results.

535.33

16836 CHARACTERISTICS COMMON TO THE NEW METHODS OF INTEFEROMETRIC SPECTROSCOPY; THE FACTOR OF MERIT.

P.Jacquinot.

J. Phys. Radium, Vol. 19, No. 3, 223-9 (March, 1958). In French.

A "factor of merit" $W = MR\ TB^{\alpha}$ is defined for any spectroscopic device, where R is the resolving power, M the number of spectral elements analysed during the total time, T, B the lowest utilizable spectral brilliance and α is an exponent having the value 1 if photon noise limits sensitivity, and the value 2 if receiver noise is preponderant. This figure of merit is, amongst other factors, proportional to: - the solid angle Ω subtended by the isolating diaphragm which must be of such diameter to yield an effective resolving power R; the transparency τ (or τ^2 in the case where receiver noise limits sensitivity); the number m of spectral elements analysed simultaneously. Most of the developmental work in spectroscopic technique has as its aim the improvement of one, or several, of these factors. The Fabry—Perot interferometer and devices using a Michelson interferometer, or more generally, systems having a rotational optical symmetry, give a value of Ω much greater than a system not having this symmetry. It is explained that such systems require for their operation semitransparent layers (or equivalent devices) which give a division of luminance of the incidents rays. This gain in solid angle is obtained with all the Fabry—Perot system using the central zone of the interference system or complete rings, in the devices of Fellgett (Abstr. 16838 of 1960), Mertz (Abstr. 16839 of 1960), Connes (Abstr. 16871 of 1960) and also in the new method of Connes (Abstr. 16835 of 1960) which employs the selection by the amplitude of interference modulation. Still further improvement in the allowed solid angle is obtained if the interfering rays are superimposed by the means of an afocal system: this is achieved, for example, in the spherical Fabry—Perot of Connes (Abstr. 16873 of 1960), which can be used in the domain of very high resolution. The photographic methods allows all the spectral elements to be registered simultaneously; the conventional methods using physical receptors examine only one element at a time which increases T, and thus reduces W. But the methods developed by Fellgett (Abstr. 16832 of 1960), Ingelstam (Abstr. 16834 of 1960), Strong and Vanasse (Abstr. 16833 of 1960) Connes (Abstr. 16834 of 1960), Merta (Abstr. 16838 of 1960) yield simultaneously a complex signal containing the information concerning a great number of spectral elements and the spectrum is reconstituted from this signal by a Fourier analysis. Hence, a great improvement of W is obtained, because of the shortening of T. These new methods are above all applicable in the domain of low resolution encountered in the far infrared, but can be used in the visible in certain particular cases. However the way in which the noise deteriorates the signal must be carefully considered if the receiver noise can be neglected. A table is given allowing a comparison of the factors of merit of the different methods.

535.33 : 551.5

16837 ATMOSPHERIC ABSORPTION SPECTRA IN THE FAR INFRARED USING TWO BEAM INTERFEROMETRY.

H.A.Gebbie.

J. Phys. Radium, Vol. 19, No. 3, 230-2 (March, 1958). In French.

For wavelengths shorter than microwaves, (where coherent generators are available), two beam interference methods have distinct advantages over usual spectroscopic methods. An example of a far infrared spectrum obtained from an interferogram by numerical analysis is given

535.33

16838 MULTICHANNEL STELLAR SPECTROMETER.

L.Mertz.

J. Phys. Radium, Vol. 19, No. 3, 233-6 (March, 1958). In French.

An inferometer has been built in order to apply Fellgett's technique (Abstr. 16832 of 1960) to stellar spectrometry in the visible. Basically it consists of a variable retardation plate between polarizers, equivalent to a section of a Lyot filter. The path difference can be varied by 175 λ at 4000 A. In order to reduce scintillation noise the path difference at 3000 c/s is modulated with an electro-optic retardation plate; complete cancellation can be obtained by measuring the ratio of a.c. to d.c. This interferometer used with the 24 inch Clark telescope easily differentiated colour and line structures of the Orion Nebuli, and the Arend—Roland comet as well of various types of stars.

53

16839 A MULTIPLEX INTERFEROMETRIC SPECTROME FOR INFRARED MEASUREMENTS ON STARS.

P.Fellgett.

J. Phys. Radium, Vol. 19, No. 3, 327-40 (March, 1958). In Fren

The interferometer was built for use at the coude focus of t 36 in.reflecting telescope of the Cambridge University Observat ries. The beam-splitter is a $\lambda/4$ layer of ZnSe on a fluorite sub strate and the mirrors are replaced by cube-corner reflectors; the beams enter the reflectors off-centre, and are returned alon the reverse direction but with a lateral shift of just over the dia meter of each beam, thus the two output beams are both accessi These two beams are focussed into a double-sided reflecting chopper which acts as the optical analogue of a double-pole reve sing switch. The two chopped beams fall on two PbS detectors, th combined outputs of which measure the amount of energy transfe by interference from one of the output beams of the interferomet to the other. One cube-corner has micrometer adjustments in t coordinates and the second cube-corner displaced by a massive 1 two-stage lever and a micrometer. Normally a driving speed 60 λ in 10 minutes is used. In preliminary observations, some dozen stars down to fourth or fifth visual magnitude were measu with a resolving power of about 60. The Fourier transforms hav been carried out numerically on Lipsom—Beevers strips; some the spectra obtained are shown.

53

16840 A DESCRIPTION OF THE FABRY—PEROT SPECTR METER INSTALLED AT BELLEVUE.

J.Blaise.

J. Phys. Radium, Vol. 19, No. 3, 335-7 (March, 1958). In French

The optical system consists of a Pellin—Broca prism used a pre-monochromator, a Littrow-type spectrograph with a Bausch Lomb grating, a Fabry—Perot etalon coated with ZnS—cryolite multilayers and a photomultiplier which is liquid nitrogen cooled. The exit slit and the collimating lens of the monochromator are focused respectively on the etalon plates and on the scanning hol The photocell is coupled to an electronic recorder through an impedance transformer of the cathode folower type (consisting of tube fed by a dry cell and accumulator). The interferometer mou allows any spacing of the etalon plates with only a few fused silic spacers. Two different devices for scanning the interference fri system by changing the air pressure in the etalon chamber are described.

535

16841 AN INTERFEROMETRIC SPECTROMETRIC SYSTEM PROPOSED FOR THE UNIVERSITY OF WISCONSIN.

J.G.Hirschberg, R.Kadesch and J.E.Mack.

J. Phys. Radium, Vol. 19, No. 3, 338-9 (March, 1958). In French.

The proposed device may include any number of gratings and Fabry—Perot etalons. The spectrum is scanned by varying the pressure. Perfect synchronism in the scanning of each element (grating or Fabry—Perot) is obtained simply by putting them all together in the same variable pressure chamber.

535

16842 THE USE OF A RECORDING INTERFEROMETER COMPLETE WITH A PRISM-MONOCHROMATOR FO THE STUDY OF THE STRUCTURES OF RAMAN LINES.

R.Dupeyrat.

J. Phys. Radium, Vol. 19, No. 3, 351-3 (March, 1958). In French

The relatively large distance between components of the Ram spectrum of a given substance (about some ten cm^{-1}) is a reason for using a coupled prism-monochromator—recording interferometer; this gives considerable luminosity improvement compare with a prism-spectrometer which has the same resolving power. A record of a ν_1 line from $GeCl_4$ obtained with this device is give Some difficulties arise, however, for lines near the incident line, or for relatively weak ones. These must be explained by superposition of incident and Raman lines. Methods are given to solve these difficulties: use of double monochromator, liquid filte interference filters or double interferometer.

535.

16843 A DOUBLE ETALON WITH PRESSURE SCANNING.

H.Chantrel.

J. Phys. Radium, Vol. 19, No. 3, 366-70 (March, 1958). In Frenc

A high resolution spectrometer using two Fabry—Perot etalo associated by intermediate focusing is described. Scanning is usually obtained by variation of air pressure between 0 and 1 atm but a special device permits very slow scanning (30 mK per hour

ans of a much smaller variation of pressure. The reprodu-
y in position of the spectral lines is the same as in a spectro-
with a single Fabry—Perot etalon; the conditions for a good
rvation of intensities in successive orders are discussed.
pparatus has been used with a ratio of etalon spacings between
15, the ratio being integral or half-integral. With the ratio
instrumental sharpness was about 300.

535.33

844 AN INTERFEROMETRIC FABRY—PEROT SPECTROMETER FOR THE INFRARED. R.G.Greenler.

s. Radium, Vol. 19, No. 3, 375-8 (March, 1958). In French.
investigate the theoretical advantage in the energy-limited
ing power of the Fabry—Perot interferometer, a compound,
ng interferometer has been constructed to operate in the 5 to
cron region of the infrared. The interferometer plates are
alt coated with Te, and NaCl or KBr multilayer films. Two
interferometer plates are used. One set is closely spaced to
a free spectral range for the other wider-spaced set, which
nes the final resolving power. Wavelength scanning is effected
echanical changing of the plate spacing. The performance of
erferometer has been tested on the 10 micron band of NH_3.

535.33

45 CHANNELLED SPECTRA IN THE DOUBLE ETALON TECHNIQUE. H.G.Kuhn and S.A.Ramsden.

s. Radium, Vol. 19, No. 3, 383 (March, 1958). In French.
hen a double etalon is used in conjunction with a spectrograph,
nation from a continuous source produces heterochromatic
s; these provide a convenient means of phase adjustment. The
d offers special advantages for weak or ultraviolet lines. See
bstr. 2085 of 1957.

535.33

846 THE METHOD AND RESULTS OF WAVELENGTH MEASUREMENTS WITH A CORNER-REFLECTOR
FEROMETER. E.R.Peck.

s. Radium, Vol. 19, No. 3, 397-9 (March, 1958). In French.
current technique of wavelength comparison is briefly
bed, and sources of errors are discussed. Preliminary results
ven for near infrared lines of Hg, Cd and He.

535.33

847 THE MEAN WAVE NUMBER OF A NARROW SPECTRAL DISTRIBUTION MEASURED BY A DOUBLE-BEAM
FEROMETER. E.R.Peck.

s. Radium, Vol. 19, No. 3, 399-401 (March, 1958). In French.
e process of wavelength comparison with the corner-reflector
erometer is shown to yield the mean wave number of a narrow
al distribution to high precision, provided the order number is
large. An estimate is made of the extreme error involved.

535.33

848 HIGH RESOLUTION SPECTROSCOPY OF ABSORPTION SPECTRA IN THE NEAR INFRARED USING THE
Y—PEROT INTERFEROMETER. J.H.Jaffé.

s. Radium, Vol. 19, No. 3, 241-5 (March, 1958). In French.
a Fabry—Perot interferometer is to be used to examine
tion spectra, no overlapping of orders can be tolerated. For
n interferometer, then, the attainable resolving power is
ed by the capabilities of the available primary monochromator.
est grating monochromators for the 1-3 μ region have resolving
limited by imperfections of the grating and not by energy. By
a Fabry—Perot interferometer in conjunction with a grating
ment of fine quality, a resolution was obtained that was
ly close to the useful limit for studies of molecular absorption
a. The spectral range between orders was only 0.175 cm^{-1}
spacer 28.6 mm) and accordingly a method was used of
ling an extended region of the spectrum. The essence of the
(called "direct unambiguous display") is to scan the spectrum
nly by pumping air between the plates and at the same time to
he monochromator along in synchronism so that the scan
ns in the selfsame order. Scanning the spectrum by gas
ng has many advantages over other methods but also has the
ack that the actual change in optical path that can be achieved
asonable pressure range is rather small. A modified technique
s scanning" is proposed. It would provide linear variation of
ical path over a wide range.

535.33

16849 SPECTROMETER INCORPORATING FABRY—PEROT [ETALONS]. R.Chabbal.

J. Phys. Radium, Vol. 19, No. 3, 246-55 (March, 1958). In French.

The qualities of luminosity and resolution of a Fabry—Perot spectrometer justify its use in many spectroscopic applications where only prisms or gratings are generally employed. But this extension is only possible if the Fabry—Perot spectrometer is transformed into an integral spectrometer, that is, one which possesses a unique band-pass which may be continuously scanned over an extended spectral region. This transformation gives rise to numerous difficulties of which the principal solutions are discussed. The conditions of operation of the Fabry—Perot, the choice of a monochromator, and the methods of spectral exploration are discussed in turn.

535.33

16850 SPECTROMETER INCORPORATING TWO FABRY—PEROT [ETALONS] FOR THE INFRARED.
R.Chabbal and P.Noorman.

J. Phys. Radium, Vol. 19, No. 3, 371-4 (March, 1958). In French.

A spectrometer with an unique band pass intended for the study at high resolution of infrared absorption spectra is described. It consists of a grating monochromator and two Fabry—Perot etalons, which give a spectral resolution of about 0.01 cm^{-1}. It is capable of exploring an extended spectral region.

535.33

16851 A DEVICE PERMITTING THE MECHANICAL DISPLACEMENT OF A FABRY—PEROT FLAT.
R.Chabbal and M.Soulet.

J. Phys. Radium, Vol. 19, No. 3, 274-7 (March, 1958). In French.

A mechanical device giving a parallel displacement to one to the flats of a Fabry—Perot etalon, which is suspended in a flexible membrane, is described. This arrangement allows a spectral scanning which is linear in cm^{-1}, during which the flats remain parallel to a high degree of precision over one order of the etalon. This device is thus useful for saw-tooth scanning, and yields a "définiance" some five times higher than the resolving power.

535.33

16852 INTERFEROMETRIC MEASUREMENTS OF WAVELENGTHS OF ABSORPTION LINES IN THE NEAR
INFRARED. D.H.Rank.

J. Phys. Radium, Vol. 19, No. 3, 402-4 (March, 1958). In French.

A general discussion of the "Method of Exact Orders" is given. Attention is paid to the necessary correction occasioned by the finite length of the exit slit and its influence in the operation of the method. The problem of dispersion of phase in dielectric films is discussed. Precision of wavelength measurement is illustrated by means of a relatively large number of wavelengths which have determined using the above mentioned methods.

535.33

16853 FABRY—PEROT FRINGES IN WHITE LIGHT USED AS WAVELENGTH STANDARDS.
F.S.Tomkins and M.Fred.

J. Phys. Radium, Vol. 19, No. 3, 409-14 (March, 1958). In French.

The term analysis of the complex rare earth and heavy element spectra requires highly accurate descriptions of these spectra in order to avoid the masking of real regularities with spurious ones, and wavelength accuracy approaching that obtainable interferometrically is desirable. Such accuracy can be obtained by photographing white light interference fringes as wavelength markers instead of the iron arc or other conventional standards, without the loss of light attendant on the usual methods of interferometry. The white light fringes provide equally spaced standards of uniform intensity and sharpness, whose wavelength values can be easily calibrated by comparison with a source such as Hg^{198}, thus avoiding the deficiencies of the iron lines with respect to accuracy, sharpness, and number. The spacing between fringes is determined by the etalon thickness and can be chosen at will. The wavelengths are determined as in the conventional method using a Fabry—Perot interferometer, by measuring the fractional order of the unknown by interpolation between neighbouring fringes, and the whole order number either by counting fringes from a known line or by calculation from the known etalon thickness if the wavelength is already known to approximately 0.1 A. In either case the interpolation distances actually measured are quite small and errors due to emulsion shrinkage or errors in the focal surface of the plateholder are minimized. Wavelengths accurate to ± 0.0003 A can be obtained using this system in the 5th order of the Argonne 30 ft spectrograph, and typical measurements are shown. Some applications of the method to the calibration of the spectrograph are discussed.

535.33

16854 INTERFEROMETRIC MEASUREMENTS OF WAVELENGTH FOR I.R.EMISSION LINES IN THE REGION 1 TO 2 μ. C.J.Humphreys and E.Paul, Jr.

J. Phys. Radium, Vol. 19, No. 3, 424-32 (March, 1958). In French.

A method has been developed for precise evaluation of spectral emission lines in the 1 to 2 μ region by interferometric intercomparison with selected internationally adopted wavelength standards. The essential feature of the method is provision for scanning the interference pattern by uniform rotation of a Fabry—Perot interferometer so that a diametral section of the system of circular fringes moves across the slit of a high-resolution infrared spectrometer. Data are obtained in the form of chart records of the fringe positions. Digital computer facilities were utilized for reduction. Aluminium coatings have proved satisfactory. Interferometer separations ranging up to 17 mm have been used in reported work, and in addition 20, 25 and 30 mm separators were used. Wavelengths have been reported as follows: A 19 lines; Kr 15 lines; natural Hg 10 lines; Hg^{198} 8 lines; Cd 4 lines; and He 1 line, namely, λ 20 581 A. The absolute accuracy achieved is 1 part in 10 000 000 in favourable cases.

535.33

16855 EXPERIMENTAL AND THEORETICAL RESEARCHES ON THE GENERAL USE OF THE FABRY—PEROT SPECTROMETER FOR VARIOUS SPECTROSCOPIC APPLICATIONS. R.Chabbal.

Rev. Opt., Vol. 37, No. 10-11, 501-51 (Oct.-Nov., 1958). In French.

For previous work, see Abstr. 3349 of 1959. Arrangements for studying hyperfine structures in the infrared are discussed. The receiving systems are reviewed and results obtained illustrated. The arrangements for securing low resolution Fabry—Perot interferometers are described. The special feature here is the high luminosity compared with other instruments. Methods of interferometer adjustment are reviewed. S.Tolansky

535.33

16856 ULTRARAPID-SCAN INFRARED SPECTROMETER. G.W.Bethke.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1054-7 (Nov., 1960).

A simple low-resolution rapid-scanning infrared spectrophotometer was developed from a modified commercial monochromator. When used with a cooled InSb or some other very fast response detector, this spectrometer is capable of over 20 000 scans per second, as limited by the present drive motor. A raster-type oscilloscope recording system is described which allows the photographic observation of many spectral scans on one oscilloscope. Sample emission spectra are shown of a xenon reflected shock and a xenon flash lamp.

535.33

16857 EXPERIMENTAL STUDY OF A SPECTROGRAPH FOR THE FAR INFRARED. M.Sergent.

Rev. Opt., Vol. 37, No. 10-11, 552-60 (Oct.-Nov., 1958). In French.

The instrument uses a plane grating (17 × 23 cm), blazed for 60 μ in the 1st order, focusing mirrors working at F/3 and a linear vacuum thermopile. Short wavelengths are reduced by depolished mirrors, rotating sectors of KBr etc., selective reflection (Reststrahlen) and quartz filter plates; the residual stray radiation with various combinations of these is tabulated. Water vapour bands up to about 60 μ are reproduced and indicate a resolution of better than 1 cm^{-1}. G.F.Lothian

535.33

16858 RATIO-RECORDING SPECTRORADIOMETER. H.K.Hammond III, W.L.Holford and M.L.Kuder.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 2, 151-7 (April-June, 1960).

This was constructed primarily for determining the relative spectral irradiance from fluorescent lamps in the visible spectrum. Radiant flux from a test source and a comparison source is transmitted or reflected by separate diffusers. The irradiance from each diffuser is sampled alternately of the order of 100 times a second by a double prism monochromator with cam-linearized wavelength drive from 360 to 760 mμ. A 14-stage multiplier phototube with S-20 response is used with an electronic gate and integrator circuits to compare the spectral irradiances from the two sources. When the phototube outputs are unequal, a servo unit adjusts apertures in each beam to equalize them. The measured parameter is the amount of adjustment required for equalization at each wavelength. The apertures are adjusted by a cam couple to a pen which records the ratio on a three-cycle logarithmic str chart. The instrument requires about 8 min to record the spectr at 10 mμ/in. An expanded scale of 1 mμ/in is used for evaluatin the energy in the spectral lines. The speed of wavelength scan n be made inversely proportional to the unbalance signal, if desire to provide ample time to record spectral lines accurately. Symmetry of beam treatment is demonstrated by interchanging test a comparison sources and recording the inverse ratio.

53

16859 HIGH-RESOLUTION GRATING SPECTROMETER. S.P.S.Porto, A.Szule, W.O.N.Guimarães and J.R.P.N

J. Opt. Soc. Amer., Vol. 50, No. 9, 921-2 (Sept., 1960).

Describes an Ebert grating spectrophotometer with photomultiplier and PbS cell detection for the visible and near i.r. reg Resolution exceeding 2/3 of the theoretical is claimed.

W.T.Wel

535

16860 A HIGH-SPEED SPECTROMETER WITH SPECTRUM SCANNING BY MEANS OF A ROTATING DISK WITH SPIRAL CUT SERVING AS THE EXIT SLIT. V.V.Kol'tsov.

Optika i Spektrosk., Vol. 8, No. 4, 582-3 (April, 1960). In Russia

A rotating disk with a cut in the form of a spiral was used a the exit slit. Rotation of the disk moved the cut across the spect and the light passed through the cut was collected by a receiver. the cut was in the form of the Archimedes spiral, $\rho = \rho_0 + k\varphi$, it could be used to obtain linear scanning along the wavelength scal a monochromator with a diffraction grating. A.Tybulew

535

16861 THE POSSIBILITIES OF USING AN INCLINED SPHERICAL MIRROR IN A SPECTROGRAPH AUTOCOLLIMATOR. Y.Grinand.

Rev. Opt., Vol. 37, No. 6, 291-4 (June, 1958). In French.

The dioptrical lens of a Littrow spectrograph may be replac by an inclined spherical mirror, provided modifications are also incorporated to correct aberrations. The experimental arrangement is described and some results presented. G.I.W.Llewe

535

16862 MECHANICAL SPECTROGRAPH SHUTTER FOR EXTREMELY SHORT EXPOSURE TIMES. W.L.Wie

Rev. sci. Instrum., Vol. 31, No. 9, 943-5 (Sept., 1960).

A mechanical spectrograph shutter for exposure times down 5×10^{-8} sec with a system for synchronization is described and performance discussed. In contrast to Kerr-cell shutters most incident light is transmitted, which is of considerable importance in extending the range of photographic spectroscopy to studies of very brief transients.

535

16863 A MONOCHROMATOR WITH AN AMMONIUM DIHYDROGEN PHOSPHATE PRISM. V.N.Vishnevskii and N.A.Romanyuk.

Optika i Spektrosk., Vol. 8, No. 5, 736-8 (May, 1960). In Russian

The present paper reports measurements of the refractive index and the absorption coefficient of ADP and shows that ADP prisms can be used in some instruments (e.g. monochromators) f work in the ultraviolet region. A.Tybulew

535

16864 THE EFFECT OF THE MONOCHROMATOR SLIT WIDTHS ON THE ACCURACY OF PHOTOELECTRIC MEASUREMENTS OF THE RAMAN LINE INTENSITIES. É.V.Chisler.

Optika i Spektrosk., Vol. 8, 359-62 (March, 1960). In Russian.

Discusses dependence of the relative r.m.s. error in measur ments of the Raman line intensities (this error is due to fluctuati of the photomultiplier current) on the width of the monochromato slit, assuming the dark current of the photomultiplier to be small compared with the photocurrent. Uses this dependence to derive optimum slit widths for various cases. A.Tybulew

535

16865 A CONTINUOUS-SPECTRUM EMISSION SOURCE CAPABLE OF SINGLE SHORT-DURATION FLASHES A.M.Shukhtin, V.S.Egorov and G.K.Tumakaev.

Optika i Spektrosk., Vol. 8, No. 3, 423-4 (March, 1960). In Russi

Describes a light-source with continuous emission between 2 and 6500 A capable of single 3-5 μ sec flashes of great intensity.

nain part of the source is a demountable capillary discharge
of 3-4 mm bore. The electrodes were connected directly to
rminals of a 0.56 μF capacitor, charged to 25-30 kV. The air
ure in the capillary was such (130-150 mm Hg) that, at a given
y potential difference across the tube, spontaneous discharges
not occur and a firing pulse fed to the tube would trigger a
arge rapidly and easily.
A.Tybulewicz

535.33

366 THE POSSIBILITY OF USE OF AMPLITUDE-PHASE OBJECTIVES FOR RESOLUTION OF TWO NON-
OCHROMATIC SOURCES OF LIGHT. A.N.Ryazanov.

a i Spektrosk., Vol. 8, No. 5, 726-7 (May, 1960). In Russian.
Amplitude-phase objectives are systems of several pairs of
lying on two sides of a common axis of symmetry, with some
slits coated with a dielectric to produce a phase shift equal
It is shown that such objectives can be used to resolve two
es of white light, which could not be distinguished by means of
orm slit.
A.Tybulewicz

535.33

867 AN INCANDESCENT LAMP WITH A MICA WINDOW FOR USE IN THE INFRARED REGION. E.N.Maleev.

a i Spektrosk., Vol. 8, No. 2, 277-8 (Feb., 1960). In Russian.
The lamp has an element in the form of a tungsten spiral, strip
nt sheet. An increase of the "blackness" of the tungsten spiral
btained by carburization (heating in benzene vapours). This
d the spectral temperature of the lamp to 2050^{0}K at $\lambda = 0.65\ \mu$.
A.Tybulewicz

PHYSICAL OPTICS

(Luminescence is included under Solid-State Physics, Liquid State, or Gaseous State)

535.39

868 LECTURE DEMONSTRATION OF OPTICAL PROPERTIES OF THIN FILMS OF DIELECTRICS AND METALS.
lerson.

. J. Phys., Vol. 28, No. 7, 654-8 (Oct., 1960).
Apparatus for demonstrating some optical properties of thin
to large audiences is described. In addition to all the thin
interference effects, one can demonstrate (a) the phase shift
rienced by the electric vector parallel to the plane of incidence
passing through the Brewsterian angle and (b) the phase shift
metal-dielectric reflection. The apparatus depends for its
ess upon the high brilliance and saturation of the reflected
ference colours from a composite metal—dielectric film. Its
ruction and properties are described.

535.39

369 CHROMATIC PROPERTIES OF REFLECTING MULTI-DIELECTRIC LAYERS. P.Giacomo.

ys. Radium, Vol. 19, No. 3, 307-11 (March, 1958). In French.
Multi-layer coatings were used as Fabry—Perot mirrors.
tions of some qualities versus wavelength were studied.
esse" F and "transparency" T measurements show that the
rption A of a "classical" coating is roughly independent of the
er of layers and wavelength. T and F are bound by the simple
ion $(1-T)/F \cong 2A/3$, which allows classification of the general
erties of such multilayers by their absorption A. If the layers
ot uniform in thickness, there is an apparent lack of planeness,
y bound to $d\psi/d\sigma$, where ψ is the derivative of the phase change
flection, and σ the wave-number. This effect may increase the
ent roughness and lack of planeness of the surface, when large
s of $|d\psi/d\sigma|$ occur.

535.39 : 535.66

3870 IRIDESCENT COLORS OF HUMMINGBIRD FEATHERS. C.H.Greenewalt, W.Brandt and D.D.Friel.

ot. Soc. Amer., Vol. 50, No. 10, 1005-13 (Oct., 1960).
The reflectance spectra of iridescent hummingbird feathers
measured spectrophotometrically for many species, and the
cture of the iridescent parts of such feathers investigated by
ron microscopy. In the direction normal to the iridescent
er surfaces the structure is found to be periodic in optical
nsions. It consists of stacks of 7-15 elliptical platelets of a
rial with refractive index ~2, each containing a structurally
reinforced air gap. To interpret the reflectance spectra in terms of the surface structures, a theory is given of reflection coefficients of stratified media with analytic refractive-index variations. The theory is applied to the iridescence of hummingbird feathers and accounts quantitatively for the iridescent colours as interference colours by reflection from the observed feather structures.

535.41

16871 THE FIELD OF APPLICATION OF THE FOURIER TRANSFORM METHOD. J.Connes.

J. Phys. Radium, Vol. 19, No. 3, 197-208 (March, 1958). In French.

It is shown that if the two beam interferometer is a Michelson interferometer with a beam of finite solid angle (which is the practical case), the instrumental line shape is the convolution of a rectangular by a sin x/x function, and the resolving power is proportional to the maximum path difference. The wavelength regions in which this method is useful, and the order of magnitude of the resolving power that can be reached were determined. The results of measurements on a particularly simple spectrum, consisting of only two lines are given: the distance between the D lines of sodium has been measured with an estimated error of 1/200 000 and the separation of a Zeeman doublet in a 800 G field with an error of 1/1 000.

535.41

16872 THE USE OF CURVED SLITS FOR THE PLACING IN TANDEM OF A DIFFRACTION GRATING WITH A FABRY—PEROT INTERFEROMETER WITH SCANNING BY PRESSURE VARIATION. J.G.Hirschberg.

J. Phys. Radium, Vol. 19, No. 3, 256-9 (March, 1958). In French.

In the case of certain high resolution measurements, absorption for instance, the usual method, developed by Jacquinot (Abstr. 8649 of 1956) and others, of employing the central region of the Fabry—Perot pattern, may result in a loss of light due to geometry. For instance, with an f/10 grating with a 1 cm high exit slit, a 50 mm diameter Fabry—Perot, and a desired resolution of 5×10^5 in absorption, the light loss due to geometry is of the order of 4/5. It is shown that the situation can be much improved in certain cases by employing curved slits to match the curvature of the Fabry—Perot interference rings.

535.41

16873 THE SPHERICAL FABRY—PEROT ETALON. P.Connes.

J. Phys. Radium, Vol. 19, No. 3, 262-9 (March, 1958). In French.

A Fabry—Perot interferometer can be made with two spherical surfaces, forming an afocal system. This interferometer can be used in a photoelectric spectrometer; it has the same transmission, contrast, sharpness free spectral range and theoretical resolving power as a plane Fabry—Perot of double thickness. But the "etendue" (product of surface by solid angle) of the beam is proportional to the resolving power instead of being inversely proportional, and the luminosity of the system becomes greater than that of the plane Fabry—Perot for very high values (several millions) of the resolving power. The spherical Fabry—Perot seems to be useful for studying lines whose width is only a few millikaysers. It could equally be used as a generator of artificial lines narrower than natural ones.

535.41

16874 EXAMINATION OF THE INTERFERENCE PATTERN BY ROTATION OF THE FABRY—PEROT INTERFEROMETER. J.H.Jaffé.

J. Phys. Radium, Vol. 19, No. 3, 273 (March, 1958). In French.

The optical path between the plates of a Fabry—Perot interferometer can be varied by rotating the instrument. Scanning in this way is not popular, probably because light is lost when the interferometer stands obliquely. However, when such losses can be tolerated there is much to commend the method. Mechanical arrangements for rotation are simple and stable. Also the range of variation of the optical path is relatively high.

535.41

16875 ELECTROMAGNETIC SWEEPING OF FABRY—PEROT RINGS. J.Gobert.

J. Phys. Radium, Vol. 19, No. 3, 278-83 (March, 1958). In French.

Scanning is achieved by varying the separation of the two flats. Parallelism of the flats is obtained by adjustment of the fixed one. The other one can be moved parallel to itself. The electromagnetic device consists of a moving cylinder, elastically mounted, and attracted by a fixed coil and damped by oil-dampers; the coil may be fed with current varying proportionally with time, or periodically; recording is done either with a pen-recorder or with an oscillograph.

535.41

16876 THERMAL SWEEPING OF FABRY—PEROT RINGS.

J.Roig.

J. Phys. Radium, Vol. 19, No. 3, 284-9 (March, 1958). In French.

Good results have been obtained with the scanning etalon plate mounted at the end of an hollow bronze cylinder. This cylinder is heated by a coil wound on the circumference, the power required is a few watts. The mounting is rigid, vibration free, and the flats remain at constant temperature and are not distorted; the precison of scanning does not depend on the separation of the flats. A cam, of simple geometrical shape, driven by a synchronous motor, controls a rheostat in the heating circuit, which thus gives a linear rise in temperature. The cam shape is calculated, and the thermal time constant of the cylinder is taken into account. The apparatus consists of two parts. (A)Photographic receivers:- a diamater of the interference pattern is imaged on the photo-plate. The plate is moved uniformly perpendicular to this diameter during the thermal scanning of the interferometer. Parabolic fringes are obtained, which are later recorded along their axis with a microphotometer. (B) Photoelectric receivers:- the centre of the interference pattern is imaged on a hole in front of a photomultiplier, and the resulting signal is measured by a recording-millivoltmeter. It is necessary to scan the fringes in a uniform way, without introducing misalignment; some designs are described.

535.41

16877 A STUDY OF ELECTRICAL SCANNING METHODS FOR RECORDING INTERFEROMETERS.

R.Dupeyrat.

J. Phys. Radium, Vol. 19, No. 3, 290-2 (March, 1958). In French.

"Pressure" scanning, with pressure varying from 0 to 1 atm, is not efficient for thicknesses less than 0.2 mm, and "mechanical" scanning is ordinarily used. The application of magnetostriction and the reverse piezoelectric effect were studied. The latter effect is more attractive, for it needs only very low power consumption, but large crystals of barium titanate must be prepared (available ceramics show some lack of similarity and fidelity).

535.41

16878 A MODIFICATION TO THE METHOD OF RECORDING INTERFERENCE FRINGES.

H.G.Kuhn and H.J.Lucas-Tooth.

J. Phys. Radium, Vol. 19, No. 3, 293-4 (March, 1958). In French.

In the previous abstracts describing direct, recording interferometry, the optical path between the etalon plates has been varied linearly with time, either by uniform change of pressure or of spacing. A pen recorder was then used to trace the electrical signal from the photomultiplier against a time base. A different method has been developed in which the signal is plotted against the air pressure directly, and which does not then depend on a uniform rate of pressure change. This is done by means of a light pointer which can move in two dimensions and produces a photographic record. Movement in the "y" direction is produced by the deflection of a mirror galvanometer and the "x" deflection by a mirror which is part of a special kind of bellows manometer giving a linear response over a wide range of pressure.

535.41

16879 THE SHARPNESS LIMIT OF A FABRY—PEROT MADE FROM IMPERFECT FLATS.

R.Chabbal.

J. Phys. Radium, Vol. 19, No. 3, 295-300 (March, 1958). In French.

The defects of the surface of the Fabry—Perot plates significantly change the properties of the etalon; these can be described by means of a function $D(\sigma)$. The ratio of the interval between orders and the width at half height of $D(\sigma)$ is called the sharpness limit (N_D). With the aid of the coefficient N_D it is possible to quickly evaluate the loss in transparency and sharpness due to the defects, and one also deduces from it the factor of reflection to be given to the plate coatings. A method for measuring the sharpness limit is given.

535.41

16880 EXTENSION OF THE SPECTRAL RANGE OF THE HIGH REFLECTANCE OF DIELECTRIC MULTILAYERS.

F.A.Jenkins.

J. Phys. Radium, Vol. 19, No. 3, 301-6 (March, 1958). In French.

Two ways of producing multilayer coatings for Fabry—Perot plates usable over a wider region of the spectrum are discussed: (1) incorption of Sb_2O_3 layers to permit use in the ultraviolet, and (2) variation of the thickness of the individual layers from the $\lambda/4$ condition to broaden the maximum of the curve of reflectance versus wavelength. The technique of producing clear films of Sb_2O_3 is described, and their refractive index is reported. Calculation of the phase shift on reflection from the de-tuned type of film shows that its dispersion is very large in certain regions of the spectrum. As consequence, interference filters made with the such films show several pass-bands that are very sharp and vary only slightly in wavelength when the spacer thickness is changed. The latter pr tion is experimentally verified, and the expected sharpness is co firmed within a factor of two. The general form of the phase sh curves shows that it may be difficult, by coating a metallic mirr with a de-tuned film, to broaden the region of enhanced reflectio without introducing narrow regions of very low reflectance. Exp mental tests confirm this. The reflectance of an aluminium mir coated with a tuned 6-layer film exceeds 95% over 2800 A, and s mirrors should be valuable where many reflections are needed.

53

16881 PREPARATION AND PROPERTIES OF REFLECTIN COATINGS FOR THE FABRY-PEROT IN THE ULTR VIOLET.

A.Steudel.

J. Phys. Radium, Vol. 19, No. 3, 312-18 (March, 1958). In Fren

Some improvement of hyperfine structure studies in the ult violet may be expected from the use of dielectric multilayer coa analogous to those used in the visible, giving at the same time h resolution and high transparency. In the region between 300 and 4000 A $PbCl_2$ meets the requirements for a highly refra medium, possessing a small absorption. Systems of nine alternate layers of $PbCl_2$ and MgF_2 possess in this region a reflectance of 97% and an absorption of only 1.9%. Below 3000 A absorption of PbCl becomes troublesome. Between 2500 and 30 however, CsI is a suitable highly refractive salt. Thirteen-laye systems of CsI and MgF_2 reach a reflectance of 92% and an abso of 3%. CsI—MgF_2 systems composed of fifteen layers give a reflectance of 95%. Dielectric multilayer coatings reflecting in ultraviolet region are almost completely transparent in the visi region. The addition of two layers each of thickness $\lambda/2$ with lo and high refractive index respectively yields a further reflectan maximum in the visible region, which permits an easy visual adj ment of the interferometer. The properties of multiple dielectr layers and aluminium mirrors are compared. At 3200 A, for exa the resolution of the dielectric mirrors is superior by a factor o coatings possess the same transparency.

535

16882 CONSTRUCTION OF INTERFEROMETRIC MIRRORS FOR THE U.V. RANGE ($\lambda > 2500$ Å).

R.Lennuier.

J. Phys. Radium, Vol. 19, No. 3, 319-20 (March, 1958). In Frenc

Dielectric mirror coatings, made of alternate high index—lo index layers, for the 2500 A region, are described. Rubidium io ($n \cong 2.0$) and cryolite ($n \cong 1.37$) are still very transparent in this region. Multilayer coatings, prepared by vacuum evaporation, of these two substances, exhibit an absorption less than 10% up to 2400 A, with reflecting power reaching 85% for 10 layers. RbI la deteriorate in humid air; coatings may be protected for several months by a k $\lambda/2$ layer of paraffin.

53

16883 REFLECTING MULTILAYERS.

J.Ring, R.Beer and V.Hewison.

J. Phys. Radium, Vol. 19, No. 3, 321-3 (March, 1958). In French

The high resolution theoretically available with multi-layer reflecting stacks cannot be obtained when optical flats are used as the support, because the surface irregularities limit the resol to a much lower value; similar effect limits the bandwidth of evaporated interference filters. Two methods are proposed to o come this difficulty: (1) use of thin mica sheets as spacing layer (2) use of reflecting stacks exhibiting a higher dispersion of phas change. Such a high dispersion may be obtained either in the wa described by Baumeister, Stone and Jenkins (Abstr. 2812 of 1956 2071 of 1957) or by the use of multilayer stacks with a small diff ence in the index of refraction between high and low index layers These stacks can also be used as narrow band reflecting filters.

53

16884 AN INTERFEROMETER WHOSE MIRRORS ARE TRANSPARENT INTERFERENCE FILTERS FOR ON AND THE SAME RADIATION σ_0.

R.Dupeyrat.

J. Phys. Radium, Vol. 19, No. 3, 324-6 (March, 1958). In French

This interferometer is characterized by a coefficient of "sharpness" and contrast varying rapidly in the pass-band of the filters; contrast and "sharpness" are low inside this pass-band, higher outside. When the apparatus is used to scan a line near a intense parasitical line, the parasitical one decreases the constr

ot the "sharpness" of the principal one to be analysed. This
s the slits of the monochromator to be opened more widely
giving more light.

535.41

385 THE EFFECT OF DISPERSION IN SYSTEMS OF THIN DIELECTRIC FILMS. F.Abelès.

ys. Radium, Vol. 19, No. 3, 327-34 (March, 1958). In French.
Considers the case of a single thin film and of semi-transparent
ors for Fabry–Perot interferometers. It is shown that it is
ble to determine the thickness of a thin non-absorbing film
its reflectivity is a maximum and when its dispersion is taken
ccount. A discussion concerning the same film, but used in
e incidence, follows. For the systems of thin alternating non-
bing layers, the influence of dispersion on the maximum
tivity on the phase-changes, on the variation of the phase-
es with the wavelength and on the width of the reflection region
sidered.

535.41

386 PRECISION MEASUREMENTS WITH THE FABRY–PEROT DOUBLE ETALON. D.A.Jackson.

ys. Radium, Vol. 19, No. 3, 379-82 (March, 1958). In French.
he double Fabry–Perot etalon is used to increase the finesse
of spectral range to instrumental width) of the fringe system,
ximately in the ratio of the plate separations of the two etalons.
the conventional photographic method of recording the fringe
m, it should be possible to measure the position of a component
ut 1/20 of its width, or about 1/4000 order with a double etalon
high ratio of the plate separations. When measurements are
to this accuracy, precautions must be taken to limit certain
matic errors. Four sources of error are discussed: (1) the
of the non-linear dispersion; (2) the error due to the mis-
nent in the vertical direction of the two etalons; (3) the error
the insufficient suppression of the subsidiary maxima, which
e serious with large ratios of the plate separations when the
ture is complicated and has high intensity ratios; (4) the
matic error, confined to atomic beam measurements, due to
oppler effect, which occurs also with the simple etalon, but is
portance only with the double etalon, due to the greater ratio
ctral range to line width.

535.41

887 PHOTOELECTRIC OBSERVATIONS WITH THE MICHELSON INTERFEROMETER. J.Terrien.

ys. Radium, Vol. 19, No. 3, 390-6 (March, 1958). In French.
t is possible to improve measurements with the Michelson
erometer by a photoelectric method, which allows extension
d the visible spectrum. The photomultiplier is the only useful
tor for narrow weak lines; it is supposed that fluctuations are
shot-noise. Optimum conditions are calculated for measure-
s of fractional order of interference, and wavelength comparison:
ameter of the hole isolating the central part of the interference
rn, and the order of interference. The accuracy of wavelength
comparison is limited at present not by photomultiplier quality
interferometer imperfections. The most necessary improve-
s are indicated. The improvements obtained justify the hope
he theoretically obtainable accuracy, of magnitude 10^{-9}, will be
ed when the causes of systematic errors, more numerous and
us than was previously supposed, have been removed.

535.41

888 ESTIMATION OF TWO CAUSES OF ERROR IN THE PHOTOELECTRIC OBSERVATION OF INTERFERENCE GES AT INFINITY WITH A MICHELSON INTERFEROMETER.

rrien.
ys. Radium, Vol. 20, No. 2-3, 446-8 (Feb.-March, 1959).
ssian.
n an earlier study (see preceding abstract) the author assumed,
erfect centring of the receiving aperture on the ring centre, and
niform illumination of this aperture in the absence of interfer-
The accuracy in centring and uniformity of illumination
red to justify these assumptions are here estimated. To
an accuracy of 0.001 of a fringe, the error in centring must be
than 0.05 of the aperture diameter and the illumination must not
y more than 12% from the centre of the aperture to its rim.

K.A.Thomas

535.41

889 INTERFEROMETRIC SYSTEMS OF CONTINUOUSLY MOVING MIRRORS AND PHOTOELECTRIC DETECTION.

Stroke.
ys. Radium, Vol. 19, No. 3, 415-23 (March, 1958). In French.
nterferometric measurements over the large path distances of several hundreds of millimetres have been recently considerably improved and simplified by the use of photoelectric receptors and electronics. Theoretical investigations of the conditions required to ensure adequate information content in the centifringe range and visibility of the fringe signals in two-beam equal-inclination interferometers permits the examination and separate verification of (1) mirror parallelism requirements needed to maintain maximum fringe signals and to reduce apparent local displacement errors by minimizing the fraction number of equal-thickness fringes within the mirror aperture and (2) inherent interferometric conditions having to do with the interferometer geometry, the source line shape and photoelectric noise characteristics. Integration of the photoelectric flux within an angular range determined by the source radius and collimator focal length leads in practice to an "effective length" per fringe different from half a wavelength by parts in 10^7. Theoretical fringe signal amplitude curves corresponding to simple single lines of Gaussian shape, such as the green Hg^{198} line, are in good accord with experiments performed over path distances of ± 320 mm and serve to estimate range and accuracy in measurements with machines where the causes of improper or variable mirror adjustments have been overcome to a large extent by mechanical perfection and servo-mechanical control.

535.41

16890 THE DOUBLE-PASSED FIZEAU INTERFEROMETER. P.Hariharan and D.Sen.

J. Opt. Soc. Amer., Vol. 50, No. 10, 999-1001 (Oct., 1960).

When the transmitted beams from a Fizeau interferometer are reflected back through the instrument, a new system of fringes is observed in which the intensity distribution undergoes a periodic modulation as the separation of the plates is changed. Accurate measurements are possible with the help of these fringes, using a photometric setting criterion. The mode of formation of these fringes, as well as the theoretical intensity distribution in them under various conditions, are discussed.

535.41

16891 CYCLIC SHEARING INTERFEROMETER. P.Hariharan and D.Sen.

J. sci. Instrum., Vol. 37, No. 10, 374-6 (Oct., 1960).

A wavefront shearing interferometer is described which can be conveniently used for routine tests of optical systems with relative apertures of f/6 or less. The necessity of equalizing the two optical paths has been eliminated in this instrument, making it extremely easy to adjust and handle. At the same time, the shear can be continuously varied, so that zonal errors can be easily identified.

535.41

16892 SIMPLE CALCULUS FOR ALL-DIELECTRIC INTERFERENCE FILTERS OF THE FABRY–PEROT TYPE.

K.D.Mielenz.
J. Opt. Soc. Amer., Vol. 50, No. 10, 1014-16 (Oct., 1960).

Chebyshev polynomials are introduced into the theory of all-dielectric first-order interference filters consisting of 2m or (2m + 1) alternating high- and low-index films of equal optical thickness β on each side of a low-index spacer of thickness 2β. For the amplitude and energy transmitted by such filters, simple closed expressions are derived that will render numerical results with greater facility than any other calculus known.

535.41

16893 A METHOD OF PRECISE FRINGE POINTING. D.S.Smith.

Canad. J. Phys., Vol. 38, No. 8, 983-90 (Aug., 1960).

Three methods of photoelectric pointing on an interference fringe are examined theoretically and the expected precision of setting is derived for each. An apparatus is described which yielded a precision of 1.2×10^9 compared to the predicted value of 5.8×10^9. The reason for this discrepancy is discussed, and a modification of the apparatus which would reduce the discrepancy is suggested.

535.41

16894 DETERMINATION OF THE INTERFERENCE-BAND ORDER USING A "MONOPRISM" AND A PLATE.

V.G.Khomazyuk.
Optika i Spektrosk., Vol. 8, No. 2, 261-3 (Feb., 1960). In Russian.

Describes a procedure for determination of the interference-band order using two plane-parallel quartz plates, one 0.9 mm thick and the other 1 mm thick (one of the faces of the latter is bevelled at an angle of 5° and is called a "monoprism"). A.Tybulewicz

535.41

16895 A CORRECTION FOR THE DIMENSIONS OF THE EXIT DIAPHRAGM IN PHOTOELECTRIC RECORDING OF EQUAL-INCLINATION INTERFERENCE BANDS.
Yu.P.Efremov and Yu.P.Kanevskii.
Optika i Spektrosk., Vol. 8, No. 2, 266-8 (Feb., 1960). In Russian.

Derives a correction for the dimensions of rectangular, square and slit-shaped exit diaphragms used in photoelectric recording of the order of equal-inclination interference bands. A.Tybulewicz

535.41

16896 PHOTOELECTRIC RECORDING OF INTERFERENCE BANDS IN WHITE LIGHT.
T.S.Kolomiitsova and I.V.Novikova.
Optika i Spektrosk., Vol. 8, No. 3, 363-70 (March, 1960). In Russian.

Describes a photoelectric method of locating and recording the central achromatic (white) band in a system of interference bands produced by white light. The method is based on the energy relationships between radiation fluxes from individual parts of the interference pattern (the central achromatic band is the brightest one). A.Tybulewicz

535.41 : 522.5

THE USE OF THE FABRY—PEROT INTERFEROMETER IN ASTRONOMY. See Abstr. 16516

535.41 : 523.87

A STUDY OF INTERSTELLAR EMISSION WITH THE AID OF A FABRY—PEROT ETALON. See Abstr. 16552

535.41 : 523.87

A STUDY OF STELLAR SPECTRAL LINES BY INCLINING A FABRY—PEROT INTERFEROMETER. See Abstr. 16553

535.41 : 551.5

A RECORDING FABRY—PEROT INTERFEROMETER FOR THE STUDY OF THE GREEN NIGHT-SKY LINE. See Abstr. 16471

535.42

16897 THE DIFFRACTION OF LIGHT BY TWO NON-ORTHOGONAL ULTRASONIC WAVES. P.Phariseau.
Simon Stevin, Vol. 33, No. 4, 161-88 (April, 1960).

The waves are of different frequencies and a plane light wave is incident at an arbitrary angle. The diffracted field is written as a Fourier series of which the terms are the spectra of different orders. Solutions for the amplitudes of the spectra are obtained as power series in a coordinate perpendicular to the plane containing the directions of propagation of the ultrasonics. W.T.Welford

535.42 : 534.2

16898 THE DIFFRACTION OF LIGHT BY AN AMPLITUDE MODULATED ULTRASONIC BEAM. P.Phariseau.
Physica, Vol. 25, No. 10, 917-23 (Oct., 1959).

A system is established of difference-differential equations, describing the diffraction of an oblique incident beam by an amplitude modulated ultrasonic beam. In order to find solutions of this system, a method of successive approximation is used. Assuming that only a few spectra appear, it is found that, as a consequence of the modulation, the diffraction lines of the first order are split into three components. The spectrum of the order zero, however, is not influenced by the modulation.

535.42 : 534.2

16899 DIFFRACTION OF LIGHT BY A THREE-DIMENSIONAL SYSTEM OF ULTRASONICS. P.Phariseau.
Physica, Vol. 25, No. 10, 924-34 (Oct., 1959).

The diffraction of a polychromatic parallel beam of light by a three dimensional array of density fluctuations produced by three non-coplanar ultrasonic sources is considered. A system of linear and homogeneous equations describing the phenomenon is set up and solutions found by a perturbation method. In this way one is able to explain qualitatively the spectra of higher order, a result which could not be obtained by other methods. It is also shown why diffraction patterns are observed when experiments are performed with "monochromatic" light.

535.42 : 538.56

DIFFRACTION THEORY IN THE k-REPRESENTATION. See Abstr. 15142

5

16900 INVESTIGATIONS OF THE DISPERSION OF LIGHT
MONO-DISPERSING SUSPENSIONS OF MASTIC.
M.Dzhurdzhya, S.Kharadzhya and V.Tsopa.
Rev. de Physique (Bucarest), Vol. 5, No. 1, 119-31 (1960). In Russian.

Perrin's method is used to form the suspensions of mastic
mean radii of the particles (r) and the number densities (N) ar
determined microscopically for three samples. The method an
apparatus used to find the turbidity (τ) are described. These p
meters are used to calculate the experimental values of the ge
coefficient of dispersion, $K = \tau/\pi r^2 N$. Mie's theory gives K as
function of $\alpha = 2\pi r/\lambda$ (λ is the wavelength of the monochromati
in the turbid medium) and of n, the relative refractive index of
particles with respect to the surrounding medium. Here, n is
to be practically constant and equal to 1.15. Mie's theory is ve
under the conditions of the experiment, by the satisfactory agre
ment between experimental and theoretical values of K when α
the interval $10 < \alpha < 70$. G.A.Ch.

16901 MONOCHROMATORS USED IN POLARIMETRY.
F.Gaume.
Rev. Opt., Vol. 37, No. 5, 242-60 (May, 1958). In French.

A study is made of the effect of using light which is not rig
ously monochromatic. The uncertainties in setting produced by
parasitic light deviating from monochromaticity are analysed.
Single and double monochromators are considered in their appl
tions to polarimetry. Both prism and interferometric (Fabry—
monochromators are reviewed. Improvements in double monoc
mator design are described. S.Tola

535.55 :

DETERMINATION OF POISSON'S RATIO BY A PHOTOEL
METHOD. See Abstr. 16196

COLORIMETRY . PHOTOGRAPHY

535.66 : 5

IRIDESCENT COLOURS OF HUMMINGBIRD FEATHERS. See Abstr. 16870

77 : 539.

16902 AN INTERMITTENT-ACTION CAMERA WITH ABSOLUTE TIME CALIBRATION.
G.Hefley, R.H.Doherty and E.L.Berger.
J. Res. Nat. Bur. Stand, Vol. 64C, No. 2, 159-65 (April-June, 19

A detailed description is presented of a film-recording sys
in which a randomly occuring event and its absolute time are
recorded simultaneously. The system consists of a 16 mm fra
camera capable of intermittent operation at a maximum rate of
140 frames per second and a clock capable of reading out time
an absolute accuracy of ±1 msec.

77 : 621.317

16903 SOME MODIFICATIONS TO AN OSCILLOSCOPE
CAMERA, AND THE CONSTRUCTION OF A CONTR
UNIT. M.H.Evans and G.Pierson.
J. sci. Instrum., Vol. 37, No. 8, 282-4 (Aug., 1960).

A Langham—Thompson series 200 camera has been modifie
provide facilities for printing frame numbers along the edge of
photographic film, and to give warning when the supply of film i
exhausted. The camera is used in conjunction with a control ci
that can provide either fully automatic operation or photography
single sweeps that have been preselected manually.

16904 SENSITIZATION OF PHOTOGRAPHIC PLATES FOR
ULTRAVIOLET REGION OF THE SPECTRUM.
I.A.Berezin and A.I.Stepanova.
Optika i Spektrosk., Vol. 8, No. 3, 408-10 (March, 1960). In Rus

Recommends a 20% solution of sodium salicylate in a 50/50
mixture of water and ethyl alcohol for sensitization of type III
spectroscopic plates in the region 2000-2300 A. The plates are
immersed in the solution for 3 sec and are dried in an air strea
for several minutes. The layer of sodium salicylate should not

d off before developing. The plates sensitized in this way do teriorate when stored for considerable periods of time.
A.Tybulewicz

77 : 539.1.07

HE INFLUENCE OF THE pH AND THE pAg OF EMULSIONS HE REGRESSION OF THE LATENT IMAGE PRODUCED BY GED PARTICLES. See Abstr. 15213

77 : 539.1.07

HE DISCRIMINATION BETWEEN RADIATIONS BY POST-OSURE TO INFRARED LIGHT AND THE CRITICAL, QUANTI-VELY CONTROLLABLE, DEVELOPMENT WITH INORGANIC ENTS. See Abstr. 15215

77 : 539.1.07

HE PARTICLE LATENT IMAGE AT HIGH TEMPERATURES. bstr. 15214

77 : 537.52

450J SPARK DISCHARGE FOR SHADOWGRAPH PHOTO-HY. See Abstr. 14994

HEAT . RADIATION

536.1

905 THE TEMPERATURE FIELD IN AN INFINITE PLATE WHEN THE HEAT TRANSFER COEFFICIENT AND TEMPERATURE OF THE ENVIRONMENT ARE VARIABLE. iselev and A.I.Lazarev.
kh. Fiz., Vol. 30, No. 6, 616-21 (June, 1960). In Russian.
is assumed that the heat transfer coefficient is an arbitrary on of the time. The equation of thermal conduction is to be d under conditions corresponding to arbitrary variation in of the temperature of the surroundings. Solutions are obtained form of integral representations which are discussed in .
R.Eisenschitz

536.2

906 A REVIEW OF HEAT TRANSFER LITERATURE 1959. E.R.G.Eckert, J.P.Hartnett, T.F.Irvine,Jr and parrow.
Engng, Vol. 82, No. 8, 47-61 (Aug., 1960).
or abstract, see Abstr. 12507 of 1960.

536.2

907 UPPER BOUNDS AND SAINT-VENANT'S PRINCIPLE IN TRANSIENT HEAT CONDUCTION. B.A.Boley.
. appl. Math., Vol. 18, No. 2, 205-7 (July, 1960).
n investigation is carried out on transient heat-conduction ems with prescribed surface temperature, and the validity of -Venant's principle in parabolic boundary-value problems is ssed.

536.2

08 APPARATUS FOR THE MEASUREMENT OF THE THERMAL DIFFUSIVITY OF SOLIDS AT HIGH ERATURES. B.Abeles, G.D.Cody and D.S.Beers.
l. Phys., Vol. 31, No. 9, 1585-92 (Sept., 1960).
n apparatus is described for measuring the thermal diffusivity ids in the temperature range 30^0-1000^0 C. It employs a method ch the dispersion and the attenuation of a thermal wave, pro-ed through the solid, are measured. The theory underlying ethod is presented, and results are given of measurements on o iron and germanium.

536.2 : 545

FFECT OF CARRIER GAS ON THE SENSITIVITY OF MAL CONDUCTIVITY DETECTORS. See Abstr.16402

536.2

909. METHOD OF MEASUREMENT OF THE THERMAL DIFFUSIVITIES OF REFRACTORY MATERIALS UP HE NEIGHBOURHOOD OF THE MELTING POINT. F.Çabannes.
ch. Cent. Nat. Rech. Sci., No. 50, 83-9 (March, 1960). In French.
he method is suitable for materials of thermal diffusitivity the order of 10^{-3} to 0.2 cm^2/sec. The specimen is in the of a small thin pill and is heated by radiation (for example olar furnace) so that the temperature of one of its faces varies oidally with frequency ν. It is shown theoretically that L^2/φ^2, where L is the thickness of the specimen and φ the phase difference between the points distance L apart, of entry and exit of the heat flux. The temperatures at the points are determined by means of radiation detectors. Full theoretical details together with suitable practical values for L and other parameters are given.
S.Weintroub

536.2

16910 CERTAIN SOLUTIONS OF THE HEAT CONDUCTION EQUATION. H.Poritsky and R.A.Powell.
Quart. appl. Math., Vol. 18, No. 2, 97-106 (July, 1960).
Considers solutions of

$$\frac{\partial T}{\partial t} = k\frac{\partial^2 T}{\partial x^2}, \qquad k = K/\rho c,$$

for $x > 0$, $t > 0$, corresponding to certain heat inputs h(t) for $t > 0$ over the plane $x = 0$: initially T vanishes for $x > 0$. ρc is the specific heat per unit volume, K the conductivity. Polynomial, half-integer and fractional heat inputs are solved.

536.2

16911 A SOLUTION TO SPECIAL HEAT CONDUCTION PROBLEMS. R.Hofmann.
Z. angew. Math. Phys., Vol. 10, No. 3, 233-44 (1959). In German.
The heating equations for cylinder, sphere and cube are computed, the starting and boundary conditions being specified for certain cases. The solution of non-stationary heating problems (considering heat sources, and starting and boundary conditions of a very general nature) was synthesized by superposition of a finite number of partial solutions.

536.2

16912 SOLUTION OF LINEAR PROBLEMS OF [THE CONDUCTION OF] HEAT WITH BOUNDARIES MOVING UNIFORMLY IN A SEMI-INFINITE RANGE. D.V.Redozubov.
Zh. tekh. Fiz., Vol. 30, No. 6, 606-10 (June, 1960). In Russian.
The one-dimensional equation of thermal conduction is solved on the assumption that the initial distribution of temperature is uniform. Boundary conditions of the conventional type are prescribed at a point on the x-axis which is moving at uniform speed towards infinity. A method of solution is established by the way of a Laplace transformation. A number of results are given explicitly.
R.Eisenschitz

536.2

16013 [THE RATE OF] HEATING OF AN INFINITE CYLINDER WHICH IS ENVELOPED IN A FILM. A.V.Minyatov.
Zh. tekh. Fiz., Vol. 30, No. 6, 611-15 (June, 1960). In Russian.
The equations of thermal conduction are formulated for the temperature in the cylinder and in the film. It is assumed that initially the temperature is uniform and that in the course of time heat is supplied from the surroundings, the temperature of which is uniform and constant but differs from the temperature of the cylinder and its coating. The differential equations are solved in an analytical form involving a transcendental equation for the determination of parameters. The solution can be simplified provided that the drop in temperature over the thickness of the film is negligible. In this case, the formulae can be evaluated by means of numerical tables which are appended.
R.Eisenschitz

536.2

16914 MEASUREMENT OF CONVECTIVE HEAT TRANSFER BY MEANS OF THE REYNOLDS' ANALOGY.
R.A.Granville and G.Boxall.
Brit. J. appl. Phys., Vol. 11, No. 10, 471-5 (Oct., 1960).
Preston's method for measuring skin friction in pipes has been extended to include non-uniform flow, with and without pressure gradients, over flat surfaces. By means of a modified form of the Reynolds' analogy, the local convective heat transfer coefficient can be related to the skin friction, and it is proposed that the method be used in aerodynamic models of furnaces and in heat transfer plant of simple geometry. More investigations are required of the effects of fluid turbulence, surface roughness and surface curvature on convective heat transfer and skin friction.

536.2

16915 TEMPERATURES REACHED IN A BIMETALLIC BRAKE DRUM. T.P.Newcomb.
Brit. J. appl. Phys., Vol. 11, No. 9, 445-7 (Sept., 1960).
A solution is given to permit the determination of the temperature attained at the friction surface of a bimetallic brake drum

during a single brake application. No assumptions are made concerning the manner in which heat is shared between the drum and lining. This solution is then compared with those obtained when all the heat generated is assumed to enter the drum, and when the amount of heat entering the drum is dependent on the thermal properties of the cast iron and brake lining material only.

536.3

16916 RADIATION FIELD FROM A RECTANGULAR SOURCE.

J.H.Hubbell, R.L.Bach and J.C.Lamkin.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 2, 121-38 (April-June, 1960).

Many radiation shielding problems involve calculations of the response of an isotropic detector to radiation of arbitrary angular distribution from uniform rectangular sources. In calculations of this type the family of integrals

$$\int_s (\cos\Theta dS/r^2)\, P_l(\cos\Theta)$$

and the integral

$$\int_s (dS/r^2)\, \exp(-\mu t/\cos\Theta)$$

are frequently encountered, where Θ is obliquity with respect to an axis perpendicular to the plane containing the rectangular radiant surface, S, r is the distance from an element of source area, dS, to the detector, μ is the attenuation coefficient, and t is the barrier thickness. Solutions of the first type of integral facilitate use of Legendre expansion representations of radiation directional distributions, and may also have application in other radiant surface studies, such as illumination and heat exchange engineering. The second integral relates to exponentially attenuated radiation from a plane isotropic rectangular source separated from the detector by a layer of material of thickness t. Formulae, expansions, and numerical results are presented.

536.3

16917 APPARATUS FOR THE MEASUREMENT OF THE NORMAL SPECTRAL EMISSIVITY IN THE INFRARED.

A.G.Maki, R.Stair and R.G.Johnston.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 2, 99-102 (April-June, 1960).

Apparatus and methods are described for measurements on metals and coatings or oxides which tightly adhere to metals. Examples of the use of this apparatus are given in measurements of the emissivity of platinum and of oxidized Inconel within the spectral region of 1.5 to 15 μ. Measured values were reproduced to better than 5 percent.

536.3

16918 BEHAVIOR OF FREELY EXPOSED ABSORBERS IN RADIATION FIELDS. J.P.Funk.

J. Opt. Soc. Amer., Vol. 50, No. 10, 986-91 (Oct., 1960).

General formulae for the absorption, emission, and radiative equilibrium temperature of arbitrary absorbers are derived and in particular those of slabs and spheres in atmospheric long-wave radiation fields. The behaviour of all nongaseous absorbers in these radiation fields is shown to be rather similar and similar again to that of a black sphere. The optical behaviour of moist air on the other hand, is shown to be completely different because of its great transparency in the "window" wavelengths. Radiation instruments of the "blackball" type can therefore neither be used for the measurement of the radiative equilibrium temperature of air nor for the divergence of the atmospheric long-wave flux.

536.3

16919 THE EMISSIVITIES OF POWDERS OF SOME REFRACTORY COMPOUNDS.

T.I.Serebryakova, Yu.B.Paderno and G.V.Samsonov.

Optika i Spektrosk., Vol. 8, No. 3, 410-12 (March, 1960). In Russian.

Reports a new method of measuring emissivities of powders and the results obtained by this method for LaB_6, NdB_6, SmB_6, GdB_6, YB_6, ZrB_2, HfB_2, B_4C, TiC, Cr_7C_3 and BN powders at temperatures from 850° to 1650° C. A.Tybulewicz

536.42

16920 THE ROLE PLAYED BY MODULUS OF RIGIDITY IN THE PROCESS OF FUSION. P.K.Chatterjee.

Indian J. theor. Phys., Vol. 5, No. 2, 21-9 (June, 1957).

A new aspect of the process of fusion is presented and a quantitative theory relating the latent heat of fusion of a substance with its modulus of rigidity is developed from very elementary considerations. The theoretical formula is then tested by applying it to a number of elements and the validity and the merit of the theory are discussed on the basis of the results of these calculations.

53

16921 SUBLIMATION OF SMALL SODIUM CHLORIDE SPH INTO ARGON. D.H.Whitmore and J.B.Moser.

J. chem. Phys., Vol. 33, No. 3, 917-20 (Sept., 1960).

The rate of vaporization of sodium chloride into an argon
atmosphere was investigated over the temperature range 726° to
770° C using a hot-stage method to follow the change of radius of
small, subliming sodium chloride sphere. In general, the press
and temperature behaviour of the empirical rate data is consiste
with the kinetic law derived by Langmuir on the basis of a model wh
assumes that the vaporization rate is controlled by molecular di
sion of sodium chloride vapour away from the surface of the sph
undergoing sublimation.

536.42 : 5

16922 EVAPORATION FROM WATER SURFACES COATE WITH A FILM OF STEARYL ALCOHOL.

B.Hellström and L.E.Janson.

K. Tekn. Högsk. Handl., No. 146, 18 pp. (1959).

Methods for affecting the evaporation from water surfaces a
described and the results of laboratory studies reported.

5

16923 THE REPRODUCIBILITY OF THE SULPHUR POINT

R.J.Berry.

Canad. J. Phys., Vol. 38, No. 8, 1027-47 (Aug., 1960).

The reproducibility of the normal boiling point of sulphur, a
fixed calibration point on the International Temperature Scale, h
been investigated using a closed manometer—boiler system. Me
urements embracing several sources of sulphur and a number of
changes in the operating conditions have shown that the sulphur
can be reproduced with a standard deviation of about 0.001°C wit
our apparatus. Tests were made on eight samples of sulphur fr
three different sources in an attempt to resolve the uncertainty
the time the sulphur takes to reach temperature equilibrium afte
has been brought to the boiling point. The results indicate that p
sulphur will reach equilibrium almost immediately but that an in
purity content of as little as 0.01% can delay equilibrium up to 1
days. The temperature—time dependence can be ascribed to the
effect of impurities on the time required for allotropic equilibri
to be attained. This hypothesis is discussed in detail and it is s
that it gives a consistent interpretation of the results presented
here and those of previous investigations. The merits of replaci
the sulphur point with the freezing point of zinc on the Internatio
Temperature Scale are also examined. The long-term stability
the coefficients of a Meyers platinum resistance thermometer is
determined and a method of improving this stability for prolonge
use at high temperatures in outlined.

5

16924 ADIABATIC CALORIMETER FOR SMALL SAMPLES

D.D.Tunnicliff and J.H.Badley.

Rev. sci. Instrum., Vol. 31, No. 9, 953-8 (Sept., 1960)

A relatively simple adiabatic calorimeter has been develope
for measuring the thermal properties of 0.5 g samples of stable
liquids or fusible solids over the temperature range of −130° to
+200° C. Adiabatic conditions are automatically maintained duri
a run by means of a control system based on the use of resistanc
thermometers and a modified commercial electronic thermoregu
Fifteen determinations on four pure compounds show that the hea
of fusion can be determined to an accuracy of about 1%. Because
the simple semi-automatic operation, the apparatus is particula
suited to the determination of the purity of organic compounds by
the calorimetric method.

536

16925 TECHNIQUES IN CALORIMETRY. I. A NOBLE MET THERMOCOUPLE FOR DIFFERENTIAL USE.

E.D.West.

Rev. sci. Instrum., Vol. 31, No. 8, 896-7 (Aug., 1960).

Describes the use, in an adiabatic calorimeter for use up to
600°C, of a thermopile made of gold—palladium versus platinum-
rhodium junctions. A comparison with Chromel—Alumel thermo
piles is made, the advantages and disadvantages being pointed ou
H.N.V.Tempe

536.65 : 53

A RELATION BETWEEN ULTRA-SONIC VELOCITY AND LATENT HEAT OF VAPORIZATION. See Abstr. 16768

THERMODYNAMICS

536.7 : 530.16

THE LAWS OF THERMODYNAMICS. See Abstr. 16641

536.7

926 STATEMENT OF THE SECOND LAW OF THERMODYNAMICS. H.L.Armstrong.

r. J. Phys., Vol. 28, No. 6, 564 (Sept., 1960).

To avoid negative statements, Lee and Sears (Thermodynamics.
ling, Mass.: Addison-Wesley Publishing Company, 1955.
3-5) define the first law of thermodynamics as
$W_{ad} = 0$, i.e. the integral around any closed cycle of adiabatic
is zero. It is now pointed out that the above could, in principle
ast, be a direct statement of experimental results, and, further
the second law might advantageously be stated in an analogous
viz., $\oint dQ/T \leq 0$. The equality applies to reversible cycles,
in principle, the integral could be again a direct experimental
lt. It is claimed that the useful consequences (e.g. Carnot's
rem and the entropy principle) can be derived much more readily
by the usual treatments. H.H.Hodgson

536.7

6927 ALTERNATIVE DERIVATION OF SOME THERMODYNAMIC FORMULAS. H.L.Armstrong.

er. J. Phys., Vol. 28, No. 7, 677-8 (Oct., 1960).

Considering a triangular infinitesimal cycle the author derives
eral thermodynamic relations by a method emphasising the
sical principles involved. E.G.Knowles

536.7

6928 THE AXIOMATIC FOUNDATION OF THERMODYNAMICS. II. I.Fényes.

phys. Hungar., Vol. 11, No. 2, 131-53 (1960). In German.

For previous work, see Abstr. 1917 of 1959. The author deals
closed systems and with systems in contact with infinite reser-
s. It is shown that given certain assumptions, the necessary
ditions for existence of extreme values of potentials and exten-
properties are also necessary and sufficient conditions for
ilibrium. Other conditions for extreme values are discussed as
l as the principle of Le Chatelier—Braun, equilibrium, and time
endence of thermodynamic processes near the equilibrium state.
E.W.Kellermann

536.7

**16929 ADIABATIC OR ISOTHERMAL EQUILIBRIUM OF A MIXTURE OF GASES IN A VESSEL OF CONSTANT
LUME AND EXPOSED TO EXTERNAL FORCES DERIVED FROM
OTENTIAL THAT IS TIME INDEPENDENT.** M.Wanner.

t. Acad. Sci. (Paris), Vol. 251, No. 2, 216-18 (July 11, 1960).
French.

Shows that thermodynamical methods can be applied consistent-
provided that allowance is made for the variation of energy and
ropy of each constituent in different parts of the vessel (caused
the external forces). It is claimed that partial separation of mix-
es of gases may be possible if the vessel is rotated and its angu-
velocity slowly changed. H.N.V.Temperley

536.7

16930 ON THE PROBLEM OF A THERMODYNAMIC SCALE FOR HIGH PRESSURES. A.V.Voronel'.

z. Metallov i Metallovedenie, Vol. 9, No. 2, 174-7 (Feb., 1960).
Russian.

Theoretical. A method of constructing a scale for ultra-high
essures is proposed which makes use of the intersection of the
versus P curves of various substances in the T—P plane (T and
denoting melting point of the substances and pressure, respec-
ely), a modified form of the Simon's equation with one arbitrary
nstant having been chosen to describe these curves. If three such
rves intersect to form a triangle, a set of 6 equations with 6 un-
own variables is obtained from which the arbitrary constant in
e equations, and pressures at the points of intersection, can be
lculated from the known temperatures corresponding to these
ints. The applicability of the method depends on the validity of
e Simon's equation, but is not affected by the possible variation of
e constant of this equation along the T versus P curve.
M.H.Sloboda

536.7

16931 THERMODYNAMIC POTENTIALS FOR SYSTEMS AT NEGATIVE ABSOLUTE TEMPERATURES. C.E.Hecht.

Phys. Rev., Vol. 119, No. 5, 1443-4 (Sept. 1, 1960).

It is shown on purely phenomenological grounds that for systems in equilibrium at negative absolute temperatures all the usual thermodynamic potentials, and in particular the energy, attain a maximum value instead of a minimum value.

LOW-TEMPERATURE PHYSICS

536.48

16932 THE PARAMETERS OF THE BENEDICT—WEBB—RUBIN EQUATION OF STATE FOR HELIUM-4. O.V.Lounasmaa.

Ann. Acad. Sci. Fennicae A VI, No. 38, 19 pp. (1959).

Experimental P.V.T. measurements of Hill and Lounasmaa (1957) in the temperature-pressure range 3°-20°K and 0-100 atm have been used for determining the eight parameters in the Benedict—Webb—Rubin (1940) equation of state for He^4. Calculations were performed with the IBM 650. The values of parameters are (units: atm, g-mole, litre, °K; R = 0.082055, Mol. wt of He^4 = 4.0028): $B_0 = 0.023661$, $A_0 = 0.040962$, $C_0 = -0.16227$, $b = -1.9727 \times 10^{-7}$, $a = -0.00057339$, $\alpha = -7.2673 \times 10^{-6}$, $c = -0.0055210$, $\gamma = 0.00077942$. The standard deviation in the compressibility factor is 0.029 and in the pressure 0.55 atm, although points up to 3 times the critical density are included. An enthalpy diagram has also been computed and the agreement with the more directly calculated values of Hill and Lounasmaa is good until densities twice the critical one. The second and third virial coefficients are in quite good agreement with earlier values above 5.2°K, the critical temperature of He^4. On the whole it may be said that the Benedict—Webb—Rubin equation reproduces the state properties of He^4 rather well and that the equation can be used with advantage in many computations.

536.48

16933 DIRECT MEASUREMENTS OF $(\partial p/\partial T)_V$ OF LIQUID HELIUM NEAR THE λ-CURVE. O.V.Lounasmaa and L.Kaunisto.

Ann. Acad. Sci. Fennicae A VI, No. 59, 15 pp. (1960).

Accurate measurements of $(\partial p/\partial T)_V$ of liquid He^4 have been made near the λ-curve at four different densities. According to the results $(\partial p/\partial T)_V < 0$, not only in the He II region, but also in contrast with older He II measurements, in the He I region near the λ-curve; $(\partial p/\partial T)_V$ becomes positive 0.04-0.07°K above the transition temperature. T_λ. The isochores thus have a minimum and the isobars a density maximum in the He I region. These results are in agreement with the entropy diagram of Lounasmaa and Kojo (see Abstr. 5228 of 1960), who found that for He I close to the λ-curve $(\partial S/\partial V)_T < 0$. As $(\partial p/\partial T)_V$ changes very rapidly near the λ-curve, it is difficult to determine how this derivative behaves at the transition point. The present results show, however, that the discontinuity in the values of $(\partial p/\partial T)_V$, if there is one, is much less spectacular than was suggested earlier and that the rate of change of $(\partial p/\partial T)_V$ is most rapid just above T_λ. Further, $(\partial^2 p/\partial T^2)_V$ might become infinite at T_λ when this temperature is approached from either side; this would be in agreement with an infinitely high specific heat anomaly on both sides of T_λ, a result in agreement with the specific heat measurements by Fairbank, Buckingham, and Kellers (1958) under the saturation vapour pressure. According to the new experimental evidence, the λ-transformation might well be of higher than second order, and it thus becomes important to measure the equilibrium properties of liquid helium as close to the λ-curve as possible. As a by-product of the experiments, the following equations were derived for the λ-curve of liquid helium:

$$p_\lambda - p_0 = 97.805(T_0 - T_\lambda) - 87.561(T_0 - T_\lambda)^2 + 62.34(T_0 - T_\lambda)^3,$$

$$\rho_\lambda - \rho_0 = 0.17930(T_0 - T_\lambda) - 0.3924(T_0 - T_\lambda)^2 + 0.3877(T_0 - T_\lambda)^3.$$

Here p_λ, ρ_λ, and T_λ are the pressure, density and temperature along the λ-curve respectively, and p_0 = 0 050 atm, ρ_0 = 0.1461 g/cm³, and T_0 = 2.1720°K are the coordinates of the λ-point under the saturation vapour pressure.

536.48

16934 STATISTICAL MECHANICS OF LIQUID He^4. R.Kikuchi, H.H.Denman and C.L.Schreiber.

Phys. Rev., Vol. 119, No. 6, 1823-31 (Sept. 15, 1960).

The partition function proposed by Feynman (Abstr. 6724 of 1953;

407 of 1954) for liquid He^4 based on his path integral method is evaluated for a simple cubic lattice considering long-range permutations as well as nearest-neighbour permutations (to which the previous analysis by one of the authors, Abstr. 255 of 1954, was restricted). The result indicates a second-order phase transition at the λ point. The marked improvements over the previous treatment are: (1) the specfic heat behaves as T^3 near absolute zero, (2) the specific heat peak is more pronounced at the λ point, and (3) when triangles are added as possible finite polygons above T_λ the specific heat just above T_λ increases over the previous result, showing an improvement. Equating the theoretical λ point with the experimental, a value for the effective mass of a helium atom about 1.6 times the normal mass is obtained.

536.48

16935 NEW MEASUREMENTS OF THE SPIN–LATTICE RELAXATION TIME IN LIQUID HELIUM 3.

G.Careri, I.Modena and M.Santini.
Nuovo Cimento, Vol. 16, No. 4, 782-3 (May 16, 1960).

These measurements were made to ascertain why three previous measurements (Abstr. 10924 of 1959, 1068-9 of 1960) were in such strong disagreement. The dependence of T_1 upon T is found to be strongly influenced by sample size and the purity of the sample. It seems likely that the measurements by Romer (Abstr. 1068 of 1960) are correct. J.M.Baker

536.48

16936 SOME REMARKS ON THE THEORY OF THE LIQUID HELIUM FILM. S.Franchetti.

Nuovo Cimento, Vol. 16, No. 6, 1158-9 (June 16, 1960).

Atkins (Abstr. 6573 of 1954) and the author (Abstr. 8563 of 1957) have shown the existence of a term $z \propto l^{-2}$ in the dependence of film thickness l on height z. Recently Dzyaloshinskij et al. (Abstr. 8641 of 1960) have come to the conclusion that there can be no such term. It is pointed out that the above term is due to the zero point energy of the Debye waves and that an essential feature is the Debye cut-off, which reflects the finite number of degrees of freedom characteristic for the atomistic structure. The Russian authors treat the liquid as a continuum. In this case the l^{-2} term disappears. H.London

536.48

16937 DAMPING OF A TORSIONALLY OSCILLATING CYLINDER IN LIQUID HELIUM AT VARIOUS TEMPERATURES AND DENSITIES. B.Welber.

Phys. Rev., Vol. 119, No. 6, 1816-22 (Sept. 15, 1960).

A method is described for measuring the product of the viscosity and the density of liquid helium by determining the energy dissipation of a piezoelectric cylinder of quartz oscillating in a torsional mode. Data are reported for liquid helium under its own vapour pressure as well as at higher densities.

536.48

16938 TRANSPORT PROPERTIES OF HELIUM II IN FINE CHANNELS.

J.Burnham, J.Reppy, G.Pearson, A.H.Spees and C.A.Reynolds.
Phys. of Fluids, Vol. 3, No. 5, 735-41 (Sept.-Oct., 1960).

The thermal conductivity of liquid He II in the interstices of a column of packed jeweler's rouge (Fe_2O_3 powder) has been found to have a temperature dependence: $\kappa \propto T$, where n falls monotonically from a value of 13 at 1.5°K to possibly zero at the lambda point. The value of the thermal conductivity at the lambda point is 0.60 ± 0.03 W/cm°K. From the flow of helium, nitrogen, and water at room temperature it is estimated that a typical rouge column provides the equivalent of about 1.4×10^9 parallel channels having an average diameter of 0.18 ± 0.02μ. The viscosity of the normal component of He II, computed from the measured conductivity on the basis of the two-fluid model, follows a temperature dependence very similar to that observed for the bulk liquid and for 52 and 108 μ capillaries above 1.9°K. The magnitude of the values, however, is lower, but in agreement with that obtained in Leiden with 0.7 μ slits. Empirical values of a correcting slip coefficient are smaller in magnitude (0.007μ) and less temperature dependent (−0.018μ/°K) than theoretical values calculated at Oxford. It was not possible, though, to rule out a phonon mean free path effect of the order of magnitude calculated by Atkins (Abstr. 1653 of 1958). Points on the lambda line have been determined from the fountain effect for pressures below 0.4 atm. The slope of the line is approximately −70 atm/°K, in agreement with the slope determined at higher pressures by other means.

53

16939 SCATTERING OF THERMAL ENERGY IONS IN SUPERFLUID LIQUID He BY PHONONS AND He^3 A

L.Meyer and F.Reif.
Phys. Rev. Letters, Vol. 5, No. 1, 1-3 (July 1, 1960).

Measurements of the mobility μ of positive and negative He
(Abstr. 4925 of 1958) are extended to lower temperatures. Belo
0.65°K for positive and 0.8°K for negative ions μ deviates belo
the exp(Δ/kT) curve, which had pointed to the rotons as the main
scatterers at higher temperatures. Assuming additivity for the
various contributions to 1/μ, the residual scattering is proporti
to $T^{3.3 \pm 0.3}$ and $T^{2.4 \pm 0.4}$ for the positive and negative ions. It i
attributed to the phonons. 1/μ is further increased by addition
He^3 at concentrations of 1.3×10^{-6} and 5.1×10^{-6}, the increase
proportional to the concentration. Assuming an ionic mass equ
to that of the neutral atom the resulting values of $D \equiv (\sigma/\pi)^{1/2}$ wh
σ is the ion—scatterer collision cross-section) are as follows:
phonons, 1.3 and 6.2 A; for He^3, 8.8 and 22.9 A; for rotons at 0.
30 and 42 A, the first figures referring to positive and the seco
negative ions. H.Lo

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16940 DISPLACEMENT-TYPE He II HEAT SWITCH.

F.J.Shore.
Rev. sci. Instrum., Vol. 31, No. 9, 966-9 (Sept., 1960).

The operation of a heat switch is described in which the co
ducting substance is liquid He II and in which the nonconducting
state is achieved by displacing the He II with a poor conductor,
e.g., Teflon. The switch is well suited for use in the first stag
of a magnetic refrigerator operating with a bath temperature n
1°K. At this temperature it performs better than a lead superconducting switch.

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16941 THERMAL PROPERTIES OF SOLID He^4.

L.Goldstein.
Phys. Rev. Letters, Vol. 5, No. 3, 104-5 (Aug. 1, 1960).

Analysis of experimental data yields negative expansion
coefficients for solid He^4 near the melting curve at temperature
below 1.5°K. Such a persistence of the anomalous properties o
liquid has been predicted by the author for He^3 in Abstr. 3699 o
Here it is made plausible for He^4 using an empirical rule about
relation between the expansion coefficients of liquid and solid
normal substances. H.L

5

16942 PERTURBATION THEORY IN STATISTICAL MEC AND THE THEORY OF SUPERCONDUCTIVITY.

D.J.Thouless.
Ann. Phys. (New York), Vol. 10, No. 4, 553-88 (Aug., 1960).

The connection between formal perturbation theory and the
modern theory of superconductivity is investigated. It is found
the condition for ladder diagrams to give a convergent sum is
identical with the condition for the temperature to be above the
critical temperature. The effect of the residual terms of the
Hamiltonian is investigated and found to be small. They give r
a correlation between electrons in the normal state, and to a
$|T - T_c|^{-1/2}$ singularity in the specific heat, but with a very s
coefficient, in both the normal and superconducting states. Th
effects are caused by the existence of a collective mode whose
spectrum becomes imaginary at the critical temperature. It is
found that, below the critical temperature, most of the diverge
is removed by using the B.C.S. Hamiltonian as the unperturbed
Hamiltonian, but that ladder diagrams with momentum exactly
still diverge. These results are not affected by the Coulomb in
action, and it is suggested that the phonon-like collective mode
continues to exist at nonzero temperatures, although it has bee
shown not to exist at zero temperature. The convergence of th
ladder diagrams is suggested as a criterion which the B.C.S.
solution must satisfy, and it is shown that this is equivalent to
requiring the B.C.S. solution to give a local minimum of the th
dynamic potential. This criterion is used to investigate some
complicated interactions. It is found that there is an interacti
which pairing of particles with opposite spin or with the same
is not possible, and a more complicated trial wave function mu
used. A predominantly P-state force is found to give a solutio
the equations which appears to represent a state with ferroma
properties.

536.48 : 5

B.C.S. ELECTRON-PAIR MODEL IN CONFIGURATION SP
See Abstr. 16637

536.48

943 MORE ABOUT SUPERCONDUCTIVITY.
L.Brillouin.

ys. Radium, Vol. 19, No. 2, 184 (Feb., 1958). In French.

n current theories the essential interaction between the super-
icting electrons takes place through phonons. The author poses
uestion how these electrons, although supported by an external
which does not participate in their movement, are nevertheless
to give rise to a stable persistent current. H.London

536.48

944 ON THE DERIVATION OF THE LONDON EQUATIONS
OF SUPERCONDUCTIVITY. A.Haug and W.Feneberg.

aturforsch., Vol. 15a, No. 7, 641-2 (July, 1960). In German.

It is shown that these equations can be derived from the
vell equations as formulated in the new classical theory of
rons (Dirac, Abstr. 981 of 1952) by imposing on the usual
ntials a suitable subsidiary condition. H.London

536.48

6945 THE MEISSNER—OCHSENFELD EFFECT IN THE
BOGOLIUBOV THEORY. J.M.Blatt and T.Matsubara.

gr. theor. Phys., Vol. 20, No. 5, 781-3 (Nov., 1958).

The inclusion of boson-like excitations in superconductivity
ry may lead to an explanation of the Meissner effect without
ation of the Buckingham sum rule. D.J.Thouless

536.48

6946 A REMARK CONCERNING THE BOGOLIUBOV THEORY.
J.M.Blatt.

gr. theor. Phys., Vol. 21, No. 3, 461-2 (March, 1959).

An interpretation of the energy gap in superconductivity theory
ven. D.J.Thouless

536.48

16947 GAUGE INVARIANCE IN THE THEORY OF SUPER-
CONDUCTIVITY. J.M.Blatt, T.Matsubara and R.M.May.

gr. theor. Phys., Vol. 21, No. 5, 745-57 (May, 1959).

By using identities first pointed out by Buckingham (Abstr.
8 of 1957) it is possible to derive explicit and manifestly gauge
riant expressions for the linear magnetic response of a
istical system. If the approximation employed for the statistical
rator fails to satisfy these identifies, the lack of gauge
riance shows itself through the fact that different explicit
ressions, which ought to give identical results, yield a whole
ge of results depending on an arbitrary function $\alpha(q)$. However,
s possible to select the best function $\alpha(q)$ by a variational
cedure. The form selected in this way is usually different from
prescription of calculating everything in London gauge, without
ing use of identities.

536.48

16948 SUPERCURRENT AND ENERGY GAP.
R.Suzuki and M.Akano.

ovo Cimento, Vol. 16, No. 3, 570-1 (May 1, 1960).

Brief report of a calculation, based on Bogolyubov's method,
ch indicates that the supercurrent passes through a maximum for
articular value of the energy gap. R.G.Chambers

536.48

16949 ENERGY GAP IN SUPERCONDUCTORS MEASURED BY
ELECTRON TUNNELING. I.Giaever.

ys. Rev. Letters, Vol. 5, No. 4, 147-8 (Aug. 15, 1960).

The tunnel current I through an Al_2O_3 film ~20A thick,
parating Al and Pb films, is found to be ohmic when the Pb is
rmal, but markedly non-ohmic when the Pb is superconducting,
applied potentials $V \leq 2$ mV. The derivative dI/dV, plotted
inst V, closely resembles the B.C.S. density-of-states curve,
indicates an energy gap for Pb of $4.2 \pm 0.1\ kT_c$.
R.G.Chambers

536.48

16950 SPEED OF THE SUPERCONDUCTING—NORMAL
TRANSITION IN TIN FILMS.

J.Oliver, M.J.Rayner and E.H.Rhoderick.

ure (London), Vol. 187, 492 (Aug. 6, 1960).

By using a pulsed magnetic field it is shown that the transition
es less than 10^{-8} sec. D.J.Oliver

536.48

16951 CRITICAL FIELDS OF SUPERCONDUCTING TIN,
INDIUM, AND TANTALUM.

R.W.Shaw, D.E.Mapother and D.C.Hopkins.

Phys. Rev., Vol. 120, No. 1, 88-91 (Oct. 1, 1960).

Precise ballistic-induction measurements of the critical field curves of tin, indium, and tantalum are reported. The measurements were made to provide more accurate data on the deviation of the critical field curves from the parabolic law. The resulting deviation functions are generally within the range of uncertainty of earlier measurements. The main experimental error in the observed deviation now arises from uncertainty in the extrapolation of the measurements to 0°K from the present lower limit of 1.1°K.

536.48

16952 SOME STUDIES OF THE SUPERCONDUCTING
TRANSITION IN PURIFIED TANTALUM. J.I.Budnick.

Phys. Rev., Vol. 119, No. 5, 1578-86 (Sept. 1, 1960).

Extremely sharp magnetic transitions from the superconducting to the normal state are found for highly purified tantalum specimens with residual resistivities approaching $1 \times 10^{-3}\ \mu$ ohm cm. Negligible flux trapping and pronounced supercooling is found to occur in these samples near the transition temperature T_c. Values of T_c as high as 4.483 ± 0.002°K and of the critical field at 0°K, H_0, as low as 830 ± 8 G were found for these specimens. The critical field curve is found to have a maximum deviation from a parabolic temperature dependence of about 3%. For tantalum the transition temperature decreases with increasing residual resistivity in much the same way as that observed by Serin and co-workers in dilute substitutional alloys. Some investigation is made of the current dependence of the resistance transition in a magnetic field.

536.48

16953 EFFECT OF ADSORBED GASES ON THE SUPER-
CONDUCTIVITY AND [NORMAL] ELECTRICAL
CONDUCTIVITY OF THIN Tl FILMS. W.Rühl.

Z. Phys., Vol. 159, No. 4, 428-42 (1960). In German.

These films were 50 to 700 A thick and were produced by condensation of thallium vapour on a crystalline quartz plate at about 100°K. At 3°K adsorbed oxygen lowers the transition temperature and slightly increases the residual resistance. Heating of the films results in a steep increase of resistivity at about 15°K and shifts the transition temperature to a considerably higher value. The changes in electrical conductivity and transition temperature increase the decreasing film thickness. With the thinnest films, the resistivity increase up to 50%. The maximum shift of the transition temperature is 0.3 deg. From the resistivity behaviour, it can be inferred that the adsorbed oxygen molecules accept conduction electrons at 15°K, thus changing the kind of their bond. This shows up in a decrease of the effective film thickness by 5 to 10 A. Results of adsorption experiments with hydrogen, nitrogen and argon are reported. These results depend to a great extent on the purity of the gases.

536.48

16954 CRITICAL FIELDS OF THIN SUPERCONDUCTING
FILMS. W.B.Ittner, III.

Phys. Rev., Vol. 119, No. 5, 1591-6 (Sept. 1, 1960).

The critical fields of thin superconducting films have been calculated on the basis of the Bardeen—Cooper—Schrieffer (BCS) theory of superconductivity (Abstr. 1708 of 1958) following a method outlined by Schrieffer. It is shown that it is convenient to use the critical field formula postulated by London where the London penetration depth is replaced by an effective penetration depth which can be specified through the use of the BCS theory. The effective penetration depth, unlike the London penetration depth which, for a given material, varies only with the temperature, is found to vary, in the BCS theory, with both the film thickness and the electronic mean free path of the normal material. This paper attempts to show that the measured critical fields of thin tin films are in general qualitative agreement with the predictions of the BCS theory.

536.48

16955 EFFECT OF PLASTIC DEFORMATION AT LOW
TEMPERATURES ON THE SUPERCONDUCTIVITY
OF GALLIUM. W.Buckel, R.Hilsch and G.v.Minnigerode.

Acta phys. Hungar., Vol. 8, No. 1-2, 5-18 (1957). In German.

Films of gallium are formed by vacuum deposition on a quartz plate. This leads to the normal lattice, if the substrate temperature is > 70°K and the film is subsequently annealed at room temperature If the deposition is carried out below 60°K a new Ga modification is formed which has a higher critical temperature. Both modifications are deformed by rolling with a steel ball at low temperature (4.2° to 38°K). The critical temperature of the normal form can be increased from 1.07°K to > 2.5°K, and in the second modification a shift of the critical temperature form 6.5°K to > 7°K is obtained. The effect of various rolling pressures and of annealing before and after rolling is investigated. H.London

536.48 : 539.2 : 538.2

16956 PROPERTIES OF SOME MAGNETIC SUPERCONDUCTORS.
R.M.Bozorth, D.D.Davis and A.J.Williams.
Phys. Rev., Vol. 119, No. 5, 1570-6 (Sept. 1, 1960).

Two solid solutions in the system $GdRu_2$-$CeRu_2$, in which both ferromagnetism and superconductivity have been observed were studied by magnetic methods. The solid solution $Gd_{0.082}Ce_{0.918}Ru_2$, which has a Curie point θ above the critical temperature T_S for superconductivity, is both ferromagnetic and superconducting. In $Gd_{0.04}Ce_{0.96}Ru_2$, for which the expected $\theta < T_S$, no ferromagnetic moment could be measured, although a small moment may be present and not detected by the methods used. In solid solutions of increasing Gd content, when θ begins to exceed the expected T_S by a considerable margin, T_S suddenly drops toward zero; and when $T_S > \theta$, θ approaches zero. Similar conclusions apply to the system $GdOs_2$-$LaOs_2$ when θ and T_S are related in the same ways. Both major and minor hystersis loops have forms not previously observed and enable one to detect ferromagnetism and superconductivity when they exist. The molecular fields resulting from the interaction between Gd atoms, and the Curie points calculated therefrom by molecular field theory, increase with increasing temperature: this is in accordance with the theory of long-range exchange forces developed by Brout.

536.48

16957 SUMMARIZED PROCEEDINGS OF A SYMPOSIUM ON THE GENERATION OF TEMPERATURES BELOW 1°K—LONDON, DECEMBER, 1959.
Brit. J. appl. Phys., Vol. 11, No. 10, 449-53 (Oct., 1960).

A one-day symposium on the methods of generating temperatures below 1°K was held by the Low-Temperature group of The Physical Society on 11 December, 1959. Six papers of a review nature were read and discussed. Attention focused primarily on the techniques of adiabatic demagnetization and on the use of He^3; nevertheless some of the more difficult techniques were reviewd with the more recently discovered properties of He^3.

536.48

16958 USE OF GRAPHITE AS LOW TEMPERATURE SUPPORT AND SHUNT FOR HEAT SWITCH.
F.J.Shore, V.L.Sailor, H.Marshak and C.A.Reynolds.
Rev. sci. Instrum., Vol. 31, No. 9, 970-3 (Sept., 1960).

Artificial pitch-bonded graphite is known to exhibit an extremely large variation of heat conductivity with temperature. It is both rigid and strong, and below 1°K its heat conductivity is exceptionally small. For these reasons it proved to be an ideal support material for use within the adiabatic enclosure of a cryostat operated below 1°K. Furthermore, above liquid nitrogen temperature graphite is an excellent heat conductor, and when used in parallel with a lead heat switch, it proves unnecessary to admit exchange gas during the precool period. The graphite exhibits a strong pumping action for helium gas at low temperatures.

536.48 : 539.2

CALORIMETER FOR THE RANGE 0.8° TO 20° K.
See Abstr. 15811

ELECTRICITY

ELECTRICAL MEASUREMENTS

537.7 : 621.317.733

15959 TRANSFORMER BRIDGES FOR USE WITH RESISTANCE STRAIN GAUGES AND SIMILAR TRANSDUCERS.
L.N.Clarke.
J. sci. Instrum., Vol. 37, No. 10, 381-4 (Oct., 1960).

A method of balancing a.c. bridges having transformer ratio arms is described which is particularly suitable for use with resistance transducers such as strain gauges. The long-time stability and accuracy of reading can be readily made better than required for most static testing by the use of an auxiliary transformer. The bridge can be combined with a commercial potentiometric recorder to form a multi-channel self-balancing a.c. bridge which can provide different ranges on successive channel The balancing system lends itself to the control of testing machi especially for the production of a given time-pattern of load or strain. The use of other types of transducer is considered.

53

16960 MULTIPLE COINCIDENCE CIRCUIT.
R.L.Chase.
Rev. sci. Instrum., Vol. 31, No. 9, 945-9 (Sept., 1960).

A general purpose "fast-slow" multiple coincidence circuit described. Three independent sets of fast coincidence condition and three independent sets of slow coincidence conditions, involving up to five input signals, can be imposed simultaneously usin a plug board and a set of patch cords. Coincidence pulse timing accomplished with the aid of a unique discriminator circuit whic can be used either to detect an early point on the rise of the inpu signals or the time of input signal zero transition. The discrimi bias can be varied over a wide range without affecting the circui recovery time. The "fast" coincidence resolving time can be adjusted from 0 to 0.18 μsec, and signal delays can be adjusted ove a 0.3 μsec range. The "slow" coincidence resolving time is fixe at approximately 2 μsec. Semiconductor active elements have b used exclusively.

537.7 : 621.375.2

16961 ULTRALINEAR CATHODE FOLLOWER.
P.L.Read.
Rev. sci. Instrum., Vol. 31, No. 9, 979-82 (Sept, 1960).

The design of a modified cathode follower circuit which possesses an extremely linear response and a voltage gain of essentially unity is presented. Analysis of the circuit shows tha in principle, the harmonic distortion may be made arbitrarily s and at the same time the voltage gain may be made arbitrarily c to unity. The modification is applied to a White cathode follower where the increase in linearity and gain is accompanied by a decrease in the output impedance. A practical modified White follo having a measured intermodulation distortion of 2×10^{-5}%, a calculated voltage gain of $(1\text{-}10^{-6})$, and a calculated output impedanc of 2×10^{-3} ohms is given.

ELECTROSTATICS . DIELECTRICS

(The study of solids through their dielectric properties is included under Solid-State Physics; similarly for Liquid State and Gaseous State)

537.2 : 621.3

16962 USEFUL LENGTH OF THE INSULATING COLUMN A SELF-EXCITING ELECTROSTATIC GENERATOR
K.S.Subudhi.
J. sci. Res. Banaras Hindu Univ., Vol. 9(2), 63-5 (1959-60: publ. June, 1959).

Experiments are described which show that the only useful part of the insulating column is that part above the earthed coro blade. E.G.Know

537.2 : 53

ELECTRIC AND MAGNETIC RESPONSE OF A THERMODYNAMIC SYSTEM. See Abstr. 16638

CURRENT ELECTRICITY

ELECTROKINETICS

(The study of solids through their electrical conduction properties is included under Solid-State Physics)

537.3 : 621.372.54

16963 SOLUTION OF LADDER NETWORKS CONTAINING LINEAR RESISTANCES. T.Kovattana and J.R.Barke
Brit. J. appl. Phys., Vol. 11, No. 9, 437-9 (Sept., 1960).

A graphical method of solving network problems involving n linear and/or negative resistances is described and fully develop for the case of ladder networks. Such networks have been used the solution of non-linear differential equations, using an analog based on finite differences, and examples are given of this application.

537.3

6964 ELECTRICAL CONDUCTION IN DEFORMED ISOTROPIC MATERIALS. A.C.Pipkin and R.S.Rivlin.

ath. Phys. (New York), Vol. 1, No. 2, 127-30 (March-April, 1960).

The current density in a deformed conductor is assumed to be a ion of the electric field and the deformation gradients. The of the relationship is restricted by invariance under changes in ntation of the physical system. Material symmetries impose her restrictions. The resulting form for isotropic materials ven. Simplifications are obtained in the cases of small deforma- and large homogeneous deformation. Generalizations and her applications are pointed out.

537.3 : 539.2

ELECTRICAL CONDUCTIVITY OF MONOVALENT METALS. Abstr. 15826

537.3 : 621.313.066

6965 THERMAL TRANSIENTS IN GRAPHITE—COPPER CONTACTS. J.A.Greenwood and J.B.P.Williamson.

t. J. appl. Phys., Vol. 11, No. 8, 389 (Aug., 1960).

This letter draws attention to two errors in a paper by Davies str. 7066 of 1960). P.M.Davidson

537.3 : 621.313.066

6966 THERMAL TRANSIENTS IN GRAPHITE—COPPER CONTACTS. W.Davies.

t. J. appl. Phys., Vol. 11, No. 8, 389-90 (Aug. 1960).

Aknowledgment of the letter by Greenwood and Williamson preceding abstract). P.M.Davidson

537.3 : 539.23

TRANSPARENT INDIUM CONTACTS TO CdS. See Abstr. 54

537.3 : 621.373.44

16967 PRODUCTION OF MILLIMICROSECOND CURRENT PULSES USING A PRESSURIZED SPARK GAP.

.Adlam and L.S.Holmes.

sci. Instrum., Vol. 37, No. 10, 385-8 (Oct., 1960).

A pressurized spark gap has been designed to discharge a mber of coaxial cables in parallel, thus producing a current pulse 10^4 A with a rise time of 4.5 mμsec. It is intended to use a number these spark gaps in parallel, and to test the feasibility of doing s, measurements have been made of the statistical variation of time lag for breakdown after triggering.

537.312

16968 PHOTOVOLTAIC EFFECT DERIVED FROM THE CARNOT CYCLE. A.Rose.

appl. Phys., Vol. 31, No. 9, 1640-1 (Sept., 1960).

An expression for the maximum power derivable from any otovoltaic device is developed in terms of the incident light ensity measured in units of black body radiation. The expression ows the linear dependence of photovoltage on light intensity at light levels, the logarithmic dependence at intermediate light els and the saturation at high light levels. The analysis is used resolve a paradox proposed by Shockley.

537.312

16969 CHARACTERISTICS OF A HIGH SOLAR CONVERSION EFFICIENCY GALLIUM ARSENIDE P-N JUNCTION.

G.Bylander, A.J.Hodges and J.A.Roberts.

Opt. Soc. Amer., Vol. 50, No. 10, 983-5 (Oct., 1960).

The characteristics of high-efficiency gallium arsenide solar ls are reported. Their open-circuit voltage is commonly greater n 0.8 V and the short-circuit current density collected is about -half that calculated on the basis of absorbed photons. The nperature coefficient for maximum power operation is .0036 per deg C. Both spectral emissivity and spectral response reported.

537.312 : 535.8

GaAs, A SENSITIVE PHOTODIODE FOR THE VISIBLE. Abstr. 16830

IONIZATION

537.56

16970 PROBE MEASUREMENTS IN THE POSITIVE COLUMN OF LOW-PRESSURE MERCURY—ARGON DISCHARGES. W.Verweij.

Physica, Vol. 25, No. 10, 980-7 (Oct., 1959).

Electron concentration, electron temperature and axial field strength were determined with the aid of Langmuir probes. The mercury pressure is varied from 0.50×10^{-3} to 90×10^{-3} mm Hg, the argon pressure from 0 to 20 mm Hg and the mean current density from 10 to 80 mA/cm^2. When very thin cylindrical probes (20 μ diameter) were used, the measurements of the electron concentration based on plasma potential and those found from the characteristic at positive probe voltage are in very good agreement. The mobility of the electrons is evaluated from the electron concentration, the electron gradient and the tube current.

537.56

16971 FORMATION OF THE HETERONUCLEAR MOLECULAR ION AKr^+. W.Kaul, U.Lauterbach and R.Fuchs.

Naturwissenschaften, Vol. 47, No. 15, 353 (1960). In German.

With a sample of Kr, which was free of Xe and enriched in Kr^{84}, an easily measured ion current was obtained for the mass number 124 in mixtures of A and Kr at pressures of the order of 10^{-5} mm Hg. As the ratios of the ion currents I_{124}/I_{40} $[AKr^+/(A^{40})^+]$ and I_{124}/I_{84} $[AKr^+/(Kr^{84})^+]$ increased linearly with the partial pressure of either Kr or A, the molecular ion of mass 124 must have been formed in a secondary process in the ion source. The formation of AKr^+ can be described as the result of a collision of an excited A atom with a neutral Kr atom. R.Schnurmann

537.56

16972 CROSS-SECTIONS FOR IONIZATION OF THE INERT GASES BY ELECTRON IMPACT.

B.A.Tozer and J.D.Craggs.

J. Electronics and Control, Vol. 8, No. 2, 103-9 (Feb., 1960).

Measurements of the total cross-sections for ionization of the rare gases argon, krypton and xenon under electron impact over the electron energy range up to 100 eV have been made with a Lozier apparatus. Measurements in argon show close agreement with those of Tate and Smith (1932) except in the low energy region, i.e. below about 25 eV.

537.56

16973 IONIZATION POTENTIAL OF FLUORINE. J.T.Herron and V.H.Dibeler.

J. chem. Phys., Vol. 32, No. 6, 1884-5 (June, 1960).

This was measured by electron impact. The value, 15.83 ± 0.05 eV found is not in good agreement with literature values. The results of measurements on Cl_2 and Br_2 are also given and second ionization potentials for these molecules reported for the first time. W.Good

537.56

16974 INVESTIGATION OF ELECTRON AVALANCHES IN AIR USING A CLOUD CHAMBER.

K.R.Allen and K.Phillips.

J. Electronics and Control, Vol. 8, No. 4, 273-88 (April, 1960).

The growth of electron avalanches has been studied in a homogeneous field electrode configuration in air using an expansion cloud chamber. The effect of such parameters as the expansion ratio, type of vapour and irradiation of the cathode on the avalanche growth has been studied. The velocity of the avalanche growth was measured in air at pressures of 400, 580 and 680 mm of Hg for values of X/p from 30 to 40 volts/cm/mm. The measurements of Raether at X/p of 41 volts/cm/mm (pressure 270 mm of Hg) tend to agree with the present experimental values extrapolated. Both the results of Nielsen and Bradbury (1937) and Townsend and Tizard (1913) appear to be higher by about 12%. Estimates have been made of the thermal energy of the electrons from both the avalanche width and velocity and large discrepancies have been found.

537.56

16975 VELOCITY AUTOCORRELATIONS OF CHARGED PARTICLES IN A MAGNETOIONIC MEDIUM WITH APPLICATIONS TO TURBULENT DIFFUSION. R.C.Bourret.

Canad. J. Phys., Vol. 38, No. 9, 1213-23 (Sept., 1960).

A system of charged particles in a slightly ionized medium is considered subject to (1) collisions with members of the neutral species, (2) a constant external magnetic field, and (3) a fluctuating force field, either external or representing the collision forces. On the assumption that their motions are satisfactorily described by the Langevin equation, the cross-correlation functions in time between velocity components of these charged particles are calculated. These functions may be used, as described elsewhere by the author, to describe the self-diffusion of the charged particles. The cases treated are: purely random external forcing, forcing by exponentially correlated (Markovian) forces, and forcing by a random series of pulses corresponding to collision forces.

537.56

16976 CHARGE TRANSFER REACTIONS PRODUCING INTRINSIC CHEMICAL CHANGE: METHYL, METHYLENE, AND HYDROGEN RADICALS PRODUCED FROM ARGON AND METHANE REACTIONS. C.E.Melton.
J. chem. Phys., Vol. 33, No. 3, 647-51 (Sept., 1960).

Charge transfer reactions producing intrinsic chemical changes in the neutral molecule have been proven by mass spectrometric techniques. The charge transfer reaction

$$A^+ + CH_4 \rightarrow A + CH_3^+ + H$$

producing an intrinsic chemical change in CH_4 was found to be more probable by a factor of five than the simple charge transfer reaction

$$A^+ + CH_4 \rightarrow A + CH_4^+.$$

Charge transfer reactions in mixtures of A and CH_4 and Kr + CH_4 were studied over the pressure range of 0.1-0.5 mm of Hg in the ionization chamber. Reactions were elucidated by catalytic and negative ion studies as well as by the usual pressure and appearance potential techniques. In the Kr + CH_4 mixture, the reaction

$$Kr^+ + CH_4 \rightarrow Kr + CH_3^+ + H$$

producing the charged radical CH_3^+ was found to have a high probability. Absolute values for rate constants and cross-sections are given for all of the charge transfer reactions observed in the A + CH_4 mixture. Products from these elementary charge transfer reactions are correlated to previously reported radiolytic, α ionization (W value), and hydride ion transfer studies.

537.56

16977 CAPTURE OF ELECTRONS BY PROTONS IN INERT GASES. V.V.Afrosimov, R.N.Il'in and E.S.Solov'ev.
Zh. tekh. Fiz., Vol. 30, No. 6, 705-10 (June, 1960). In Russian.

The total cross-sections for the capture of a single electron by protons in helium, neon, krypton and xenon were calculated in the energy range 10-180 keV, as were those for the capture of two electrons by protons in argon. It was found that the cross-section for the two electrons fell with increasing energy considerably faster than that for the single electron. The investigation also included the angular distribution of fast hydrogen atoms and H^- ions excited as a result of the electron capture, and that of protons scattered in argon. It was concluded that two-electron capture occurs for tighter binding of the proton to the atom than does the capture of single electrons. A.E.I. Research Laboratory

ELECTRIC DISCHARGES

537.52

16978 CERTAIN PECULIARITIES OF THE INDUCTION DISCHARGES IN GASES. É.D.Andryukhina, S.E.Grebenshchikova, M.S.Rabinovich, M.D.Raizer, A.Ya.Safronov and I.S.Shpigel'.
Zh. tekh. Fiz., Vol. 30, No. 5, 529-38 (May, 1960). In Russian.

Presented at the 4th International Conference on Ionization Processes, Upsala, 1959. Describes the results of experiments which were carried out to explain the effect of the following phenomena on plasma dynamics: the carrying away of magnetic fields by moving plasma, skin effect and shock waves. The experiments were carried out in axially-symmetrical homogeneous and heterogeneous magnetic fields, using a wide frequency range, mostly in cylindrical glass chambers (in H and air) at pressures of 0.5-0.01 mm Hg. The "capture" of a magnetic field by plasma is described and discussed in detail. The experiments on the skin effect and shock waves, showed that, when the spark-over took place at pressures referr
to above, a cylindrical shock wave was produced which was pinch
towards the axis of the system. During propagation it heated the
and partly ionized it. At high discharge frequencies (300-700 kc
a skin layer, whose thickness was less than the height of the char
could be formed when plasma was sufficiently conducting; this wa
obtained after 2-3 shock waves passed through the vacuum volum
A qualitative relationship $\delta \sim \omega^{-1/2}$ was observed in experiments,
where ω is the frequency, and δ is the thickness of the skin layer
F.Lachr

53

16979 ELECTRON TEMPERATURE IN ELECTRODELESS DISCHARGE SUBJECTED TO A TRANSVERSE MAGNETIC FIELD. S.N.Goswami.
Indian J. Phys., Vol. 33, No. 10, 452-5 (Oct., 1959).

Values have been obtained from mobility data and mobility variation with pressure. The apparent discrepancy with the published data is indicated in two cases; (1) effect of magnetic fie
and (2) high value of X/p.

575.52 : 5

THE EJECTION PHENOMENON IN AN ELECTRIC DISCHAR
See Abstr. 15116

53

16980 ON THE ALIGNMENT OF GASEOUS DISCHARGES IN CROSSED ELECTRICAL AND MAGNETIC FIELDS.
G.Boucher and O.Doehler.
C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 59-61 (July 4, 1960). In French.

Describes a tube which displays the general properties of a
Penning gauge, but with a special configuration of the magnetic f
localized near one of the electrodes. J.D.Cra

53

16981 THE DISTRIBUTION FUNCTION OF ELECTRONS B
THEIR VELOCITIES IN THE POSITIVE COLUMN O
MEDIUM-PRESSURE DISCHARGE. Yu.M.Kagan and K.S.Musta
Zh. tekh. Fiz., Vol. 30, No. 8, 938-47 (Aug., 1960). In Russian.

These functions are calculated for Ne, A and Hg at pressure
0.1-20 mm Hg, both the elastic and inelastic collisions being tak
into account. The obtained mean values of energy (temperature
the electron gas) agree well with the results of probe measurem
F.Lach

53

16982 DEVELOPMENT OF THE PULSE DISCHARGE IN NE
AT SUPER-HIGH FREQUENCIES. V.E.Golant.
Zh. tekh. Fiz., Vol. 27, No. 7, 1482-94 (July, 1957). In Russian.

The critical field strength for the discharge in neon under
square s.h.f. pulses was determined by calculating the velocity d
bution function for electrons, the coefficient of ionization of neon
atoms by electrons, the coefficient of capture of electrons by, wa
molecules and the high-frequency conductivity of neon. The calc
lations apply to the case when the diffusion of electrons during th
discharge is negligible. Comparison is made between the theory
experiment. Z.Kras

53

16983 THE EFFECT OF A CONSTANT LONGITUDINAL MAGNETIC FIELD ON THE HIGH FREQUENCY MERCURY DISCHARGE. S.D.Vagner and N.I.Van'chkova.
Zh. tekh. Fiz., Vol. 29, No. 12, 1475-7 (Dec., 1959). In Russian.

Investigations were made of the radial distribution of ions i
discharge at 7.5 Mc/s in mercury vapour at low pressure both
with and without the magnetic field. It was found that although th
centration of ions across the section of the discharge increased
the magnetic field, the radial variation of the ratio of concentrat
at radius r to that on the axis remained practically unchanged.
effect of the magnetic field on the discharge in a tube with intern
electrodes was the same as that for external electrodes.
Z.Kras

537.52 : 621

16984 THE ANODE REGION IN A LOW-PRESSURE GAS DISCHARGE. III. THE APPEARANCE OF ADDITIO
PLASMAS ON THE ANODE (ANODE SPOTS).
B.N.Klyarfel'd and N.A.Neretina.
Zh. tekh. Fiz., Vol. 30, No. 2, 186-98 (Feb., 1960). In Russian.

For Pt II see Abstr. 9037 of 1960. A detailed study was mad

e spots in mercury vapour, inert gases and hydrogen. Inserting obe into the spot from the direction of the anode facilitated the stigation of the properties of the spot itself. The distribution of s on the anode in the form of a regular pattern is explained by the action of each spot with the surrounding discharge space.
Z.Krasucki

537.52

6985 ELECTRICAL EROSION ON MONOCRYSTALS.

L.S.Palatnik and A.A.Levchenko.

stallografiya, Vol. 3, No. 5, 612-16 (Sept.-Oct., 1958). In Russian. lish translation in: Soviet Physics—Crystallography (New York), . 3, No. 5, 618-21 (Dec., 1959).

A qualitative study of the damage produced on monocrystal ctrode surfaces by a spark discharge. Anode surfaces show cular pits surrounded by plastically deformed regions: the types leformation (slip, twinning, cleavage) are listed for fifteen metals. hode surfaces show angular pits: the shapes depend on the stallographic orientation of the surface.
D.G.Holloway

537.52

16986 CORONA RELATIONSHIP UNDER LOW FREQUENCY SILENT ELECTRIC DISCHARGE.

.Jatar and H.D.Sharma.

c. Nat. Acad. Sci. India A, Vol. 26, Pt II, 87-93 (March, 1957).

The corona relationship is investigated for l.f. silent electric charge in air in the range of pressure from 1-250 mm Hg, using ze counter type discharge tubes. The corona relationship is found old if a correction is made for the fall of potential on the glass ls.

537.52

16987 DEPENDENCE OF THE [ELECTRIC] ARC STABILITY ON THE STATE OF THE CATHODE.

.Kesaev and L.A.Levshenkova.

tekh. Fiz., Vol. 30, No. 7, 815-16 (July, 1960). In Russian.

Experiments with mercury, bismuth, lead and tin showed that idification of a liquid cathode extended the duration of an arc disrge and reduced the cathode fall.
A.Tybulewicz

537.52

16988 THE DECAY TIME OF THE CATHODE SPOT IN MERCURY. V.M.Mantrov.

tekh. Fiz., Vol. 30, No. 6, 672-3 (June, 1960). In Russian.

From an oscilloscopic observation of the decay of the electron rrent from the cathode spot the decay time was found to be not ss than 0.1 μsec.
J.M.Zarzycki

537.52 : 621.387

16989 THE PHENOMENA OF INTERNAL INSTABILITY OF AN ARC WITH A MERCURY CATHODE. I. SPONANEOUS EXTINCTIONS OF THE ARC. I.G.Kesaev.

, tekh. Fiz., Vol. 29, No. 12, 1462-72 (Dec., 1959). In Russian.

A statistical investigation was made of spontaneous extinctions an arc in the low-current region. The mean life of the arc Θ, s taken as the measure of instability. The investigations included e determination of the dependence of Θ on parameters of the exterl circuit (average current, inductance of the circuit, capacitance ross the electrodes), and on internal conditions of the discharge resence of inert gases and air and the effect of longitudinal agnetic field on the arc).
Z.Krasucki

537.52

16990 CATHODE OF AN ARC IN XENON.

J.E.White.

appl. Phys., Vol. 31, No. 10, 1709-14 (Oct., 1960).

Energy balance, space charge, and thermionic equations have en combined to provide a description of the mechanism of the thode in an a.c. arc, and the quantities required for solution termined experimentally. The experiments were carried out on rium-activated electrodes in xenon at 1.4 atm and extended over range of 25-75 A r.m.s. The work function was found to be 1.77 V zero-field and reduced to 1.67 V under Schottky effect of the space arge field. The work function did not change with current, but e Richardson—Dushman A fell, as the current was raised, to a lue of approximately 0.1 at the highest load. The cathode fall ried with phase angle and showed a maximum of 1.2 V at maxim current. The component of current at the cathode carried by s reduced from 12% to 6% as the load increased.

537.52

16991 IMPORTANCE OF INSULATING INCLUSIONS IN ARC INITIATION. R.Hancox.

Brit. J. appl. Phys., Vol. 11, No. 10, 468-71 (Oct., 1960).

The initiation of arcs on a metal surface in contact with a plasma (ion density about 10^{14} ion/cm^3) has been studied with metal specimens known to contain microscopic alumina inclusions. The specimens were biased negatively with respect to the plasma, and for voltages above 300 V the time lag before arcing occurred was inversely proportional to the positive ion current drawn by the specimen from the plasma, but independent of voltage. At lower voltages the time lag increased rapidly with decreasing voltage. Arcing was also independent of the nature of the ions and the pressure of neutral gas in the plasma. These results are consistent with the initiation of the arcs by dielectric charging and breakdown of the inclusions.

537.52

16992 PROBES AT HIGH PRESSURE.

J.E.White.

J. appl. Phys., Vol. 31, No. 8, 1502-3 (Aug., 1960).

Describes the measurement of local "space" potentials in plasmas at pressures higher than those generally obtaining in probe studies. Reference is made to xenon arcs at 1.4 atm pressure and 50-100 A r.m.s. current.
J.D.Craggs

537.52

16993 THE RADIAL DENSITY AND TEMPERATURE VARIATIONS IN THE VERY HIGH PRESSURE MERCURY LAMPS HBO 500, HBO 200 AND HBO 107.

H.Burck and Ku Dschi-Yü.

Exper. Tech. der Phys., Vol. 8, No. 2, 81-9 (1960). In German.

Describes measurements made on certain types of lamp with pressures ranging from 35-75 atm (6000-12 000^{0}K). Density measurements were made with the X-ray absorption method.
J.D.Craggs

537.52

16994 SOME POST-BREAKDOWN PROCESSES IN AIR.

I.E.Balygin.

Zh. tekh. Fiz., Vol. 30, No. 4, 433-41 (April, 1960). In Russian.

Measurements were made at room temperature and atmospheric pressure using spherical and point—plane electrode systems with gaps of 2-6 mm and pulse voltages. At a certain resistance-limited current, the de-ionization processes in the spark channel were quite intense. The intensity of de-ionization after breakdown first decreased with time and then increased again at the moment of extinction of the discharge. Under some conditions, high-frequency sinusoidal oscillations developed in the spark channel. The breakdown strength of ionized air was considerably lower than that of non-ionized air.
Z.Krasucki

537.52 : 621.315.618.2

16995 HIGH-FREQUENCY BREAKDOWN OF AIR.

D.Kelly and H.Margenau.

J. appl. Phys., Vol. 31, No. 9, 1617-20 (Sept., 1960).

Kinetic theory is applied to the problem of ionization breakdown of the air surrounding a high-speed vehicle. It is found that electrons are removed primarily by being swept out of the field of the moving aerial, and that in the interesting cases this action predominates over diffusion losses. Breakdown voltages are plotted against altitude for frequencies of 225 Mc/s, and 1 and 10 kMc/s. The theory may offer an explanation of some types of signal loss during missile flights.

537.52 : 621.315.618.2

16996 ELECTRICAL BREAKDOWN IN VACUUM BETWEEN GRAPHITE ELECTRODES. I.N.Slivkov.

Zh. tekh. Fiz., Vol. 29, No. 12, 1473-4 (Dec., 1959). In Russian.

Measurements were made of the dependence of breakdown strength between graphite electrodes of different configurations on the electrode gap using pulse voltages (1.5-40 μsec). Bearings of the results on the mechanism of breakdown are discussed.
Z.Krasucki

PLASMA

537.56

16997 A NEW PLASMA CONFINEMENT GEOMETRY.
J.L.Tuck.

Nature (London), Vol. 187, 863-4 (Sept. 3, 1960).

In order to avoid synchrotron radiation from a high-temperature plasma, which might nullify attempts to produce a thermonuclear reactor, a new confinement system, based on a helical conductor contained within a torus or linear system, is proposed. Confinement (stable) is in a series of linked cusps from which losses are zero in a toroidal arrangement or reducible to an arbitrarily small quantity.

C.G.Morgan

537.56

16998 CIRCUIT DYNAMICS OF THE PINCH.
J.Killeen and B.A.Lippmann.

J. appl. Phys., Vol. 31, No. 9, 1549-54 (Sept., 1960).

Instead of analysing a portion of an hydromagnetic pinch apparatus in detail, and replacing the remainder by a boundary condition, the entire pinch apparatus is treated here as a single dynamical system. A circuit equation and a mechanical equation, coupled together, result. These equations describe the dynamical development of the pinch and exhibit explicitly its dependence on the physical parameters (electrical and mechanical) of the system. As examples, the equations have been used to analyse the snow-plough model and the adiabatic pinch, yielding curves that show the geometrical development of the pinch in time, as well as the distribution of mechanical and magnetic curves at any stage. Analogous analyses may be made for other physical quantities of interest, and can be used to adjust the parameters of the system so as to optimize specific pinch characteristics.

537.56

16999 PHENOMENA OF MOTION IN THE LINEAR [STABILIZED] PINCH EFFECT AND RUNAWAY ELECTRONS. E.Fünfer, G.Lehner and H.Tuczek.

Z. Naturforsch, Vol. 15a, No. 7, 566-74 (July, 1960). In German.

The time dependence of plasma radius and current is calculated assuming a homogeneous plasma. Comparison with experiment shows good agreement with regard to the contraction times. Especially it is found theoretically and experimentally that the contraction times are independent of the stabilizing magnetic field. Measurements of the longitudinal magnetic flux give the time and spatial dependence of the induced azimuthal electric field in good agreement with the theory. A deviation at the beginning of the compression is attributed to the paramagnetic effect. Comparison with the theory of Dreiger shows that the measured field strengths are sufficient for the production of runaway electrons. This could explain the hard X-rays which are found experimentally.

537.56

17000 PLASMA INJECTION INTO A MAGNETIC FIELD OF CUSPED GEOMETRY.

F.H.Coensgen, A.E.Sherman, W.E.Nexsen and W.F.Cummins.

Phys. of Fluids, Vol. 3, No. 5, 764-68 (Sept.-Oct., 1960).

A plasma stream was directed from a field-free region along the axis of symmetry into a magnetic field of biconical cusped geometry. No evidence was found to support the hypothesis that a directed plasma stream can not penetrate a magnetic field whose value exceeds $B_c^2 = 12\pi\rho v^2$, where ρ is the plasma density and v its directed velocity. As the plasma penetrated the magnetic field, the plasma and field were found to intermix. Large quantities of the plasma which entered the containment region through one point cusp were found to leave promptly through the second point cusp and through the line cusp. Bombardment of the vacuum chamber walls in the vicinity of the line cusp generated sufficient secondary ions to mask any small scale plasma trapping. However, there was no evidence of gross trapping of the injected plasma.

537.56

17001 POSSIBILITY OF AN ELECTROSTATIC INSTABILITY IN A STELLARATOR.

R.A.Ellis, Jr, L.P.Goldberg and J.G.Gorman.

Phys. of Fluids, Vol. 3, No. 5, 797-9 (Sept.-Oct., 1960).

At certain times during ohmic heating in hydrogen and deuterium discharges in the B-3 stellarator, it was observed that over a wide range of experimental conditions the plasma current decreased abruptly (current inhibition) following a period of increasing current and decreasing charged particle density. It is suggested that this may be a manifestation of an electrostatic instability.

53

17002 MAGNETIC TRAP WITH ROTATING STOPPERS (MIRRORS). L.I.Rudakov.

Zh. tekh. Fiz., Vol. 30, No. 8, 907-12 (Aug., 1960). In Russian.

A trap with static magnetic stoppers only holds plasma parti travelling at an angle to the lines of force. When, however, there excited in the plasma an electromagnetic oscillation of large amplitude, a new force enters and effectively prevents the escape of particles which would otherwise have been lost. This principl can be used to refine the exit cone of the particles.

A.E.I. Research Labora

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17003 STATISTICAL MECHANICS OF RELATIVISTIC STREAMS. I.

K.M.Watson, S.A.Bludman and M.N.Rosenbluth.

Phys. of Fluids, Vol. 3, No. 5, 741-7 (Sept.-Oct., 1960).

The small amplitude motion of a relativistic beam passing through plasma is studied using transport theory. For the equil brium state, a relativistic Maxwellian velocity distribution is ob tained. The linearized Boltzmann equation is used to relate bea and plasma density and current perturbations to perturbations i the electromagnetic field. Approximate criteria are obtained to justify the neglect of static fields. Finally, these general result are specialized to those of a uniform beam.

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17004 STATISTICAL MECHANICS OF RELATIVISTIC STREAMS. II.

S.A.Bludman, K.M.Watson and M.N.Rosenbluth.

Phys. of Fluids, Vol. 3, No. 5, 747-57 (Sept.-Oct., 1960).

The stability of a uniform relativistic beam of particles injected into a plasma is studied using the previously developed linear transport theory. Velocity distribution in the beam and electron-ion collisions in the plasma are considered. For wave propagation in the beam direction, an exact treatment is given, while for oblique angles between plasma waves and the beam tw kinds of perturbation theory are developed. It is found that the electromagnetic modes of beam-plasma oscillation are always stable, but that growing electrostatic oscillations are possible f long enough wavelengths. For short wavelengths or high temper tures this mode is also stable. Boundary effects and the effects static fields are not considered.

537.56 : 53

17005 A PERTURBATION METHOD FOR PROPAGATION ELECTROMAGNETIC WAVES IN A PLASMA WHICH PARTIALLY FILLS A CIRCULAR WAVEGUIDE. L.Cairó.

C.R. Acad. Sci. (Paris), Vol. 250, No. 25, 4129-31 (June 20, 1960 In French.

First a solution is given for a plasma without an external magnetic field. When the field is applied off-diagonal terms app in the dielectric tensor and one of the diagonal elements changes Perturbation methods are presented for the change in propagatio constant β. The integral of the Poynting vector over the plasma appears but is not directly calculated. Instead it is found by mea of a virtual perturbation of the plasma radius r_1 and permeabilit which establishes a relation between this integral and $d\beta/dr_1$ whi in turn can be calculated from the unperturbed solution. H.

537.56 : 53

SOLUTION OF THE COLLISIONLESS BOLTZMANN EQUATION FOR A PLASMA. See Abstr. 16621

537.56 :

"TWO-FLUID" PLASMA MODEL FOR HIGH ELECTRON TEMPERATURES. See Abstr. 16731

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17006 DRIFT INSTABILITIES IN A MAXWELLIAN PLASM
E.A.Jackson.

Phys. of Fluids, Vol. 3, No. 5, 786-92 (Sept.-Oct., 1960).

The stability of two Maxwellian components of a plasma, wh have different drift velocities, is investigated by means of a gra ical solution of the dispersion relation. The graphical technique has the advantage of exhibiting the content of the dispersion rela in a transparent manner. By this method the region of instabilit was determined as a function of the perturbation wavelength λ a the relative velocity of the components, and it was shown that th region depended on the ratio of the Debye lengths and plasma frequencies. In the case of an electron—proton plasma the maxi growth rate was obtained as a function of λ and the critical drif ity as a function of the temperature ratios. The structure of nstable region was also indicated by a few lines of constant h rate.

537.56

007 EQUILIBRIUM PROPERTIES OF A PARTIALLY IONIZED PLASMA.

Harris, J.E.Roberts and J.G.Trulio.
. Rev., Vol. 119 No. 6, 1832-41 (Sept. 15, 1960).

model for a partially ionized, partially dissociated plasma een formulated using known theoretical concepts to describe bound and free electron states, internal molecular degrees of om and Coulomb interactions. It has been applied to a system rticles arising from the hydrogen molecule. The Coulomb action is treated in the classical Debye approximation. However, tance of closest approach between ions and electrons depending e kinetic energy of the electrons is included to avoid the short- divergence of the Coulomb potential. The kinetic energy of the electrons is calculated from the partition function for a perfect ni gas. The vibrational and rotational motion are treated in the onic oscillator and rigid rotor approximation with the number of gy levels counted for a given electronic state depending on the ciation energy of the state. A volume dependence of the bound ronic energy eigenvalues is included by considering the effect rrounding particles as a confinement of a given particle to a rical box of variable size. For the counting of the bound ronic states, a given state is bound until its energy increases ro due to confinement. From the partition function for the e system, the free energy is calculated. By a minimization of ree energy of the system, the equilibrium composition as a tion of temperature and volume is obtained. Then not only can modynamic quantities be calculated, but it is believed that a onable approximation to the correct balance of molecular, ionic free electronic states is achieved over a wide range of v—T e. Consequently, regions where incomplete ionization and ociation are important are delineated. In addition, for different ons of v—T space, the relative contributions of charged particle raction of the nonclassical behaviour of electrons, of internal ees of freedom and of translation to the total energy of the system be determined.

537.56

17008 BEHAVIOUR OF A PLASMA IN AN ALTERNATING MAGNETIC FIELD.

Zolototrubov, N.M Pyzhov, I.P.Skoblik and V.T.Tolok.
tekh. Fiz., Vol. 30, No. 7, 769-73 (July, 1960). In Russian.

Two single-turn coils encircling a gas discharge tube and ed to a bank of capacitors provide the magnetic field. The change e field with time sets up an e.m.f. which produces a plasma dis- rge. The plasma interacts with the field and becomes compressed radially and axially. With compressed hydrogen plasma, radial llations are noted. A.E.I. Research Laboratory

537.56

009 A CONTRIBUTION TO THE THEORY OF AN ELECTRON PLASMA IN A MAGNETIC FIELD.

.Bonch-Bruevich and A.G.Miranov.
. tverdogo Tela, Vol. 2, No. 3, 489-98 (March, 1960). In Russian.

A Green's function method is used to investigate the behaviour non-degenerate electron plasma in a constant magnetic field. spectrum of plasma oscillations is obtained; in particular, the iting wave number of the oscillations and the damping coefficient calculated, with full allowance for quantum effects. The eening law for an external electric field (in the presence of a netic field) is also investigated. O.Penrose

537.56

7010 CHARACTERISTICS OF GAS DISCHARGE PLASMA IN MAGNETIC FIELD. T.Okuda and K.Yamamoto.

n. Fac. Engng Nagoya Univ., Vol. 11, No. 1-2, 130-6 (Nov., 1959).

Concerned with the characteristics of a plasma in a longitudinal netic field. In a uniform field, a contracted column is character- , while in a non-uniform field an anomalous plasma distribution e direction of the magnetic field is distinctive.

537.56

7011 ELECTRIC FIELD CORRELATION AND PLASMA DYNAMICS. J.B.Taylor.

s. of Fluids, Vol. 3, No. 5, 792-7 (Sept.-Oct., 1960).

The correlation function for the electric field in a fully ionized sma is derived, and its application to the problem of finding the e on a charge moving slowly through a plasma is described. The correlation function is evaluated for a plasma with and without a magnetic field, and this function is then converted to the spectrum of the mean-square fluctuation in the random electric field. The application of the generalized fluctuation—dissipation theorem gives the mean force on a slowly moving test charge. The relation of this to other treatments is briefly discussed.

537.56

17012 MANY-VALUED NATURE OF THE SCALAR MAGNETIC POTENTIAL IN THE HYDROMAGNETIC STABILITY PROBLEM OF A PLASMA. R.Lüst and E.Martensen.

Z. Naturforsch, Vol. 15a, No. 8, 706-13 (Aug., 1960). In German.

Bernstein, Frieman, Kruskal and Kulsrud (Abstr. 4159 of 1958) have found a variational principle (energy principle) which provides a necessary and sufficient condition for the stability of a plasma configuration surrounded by a vacuum and an external conductor. In this energy principle the perturbed magnetic field in the vacuum is derived from a vector potential. In the present investigation the energy principle is formulated with the help of a magnetic scalar potential instead of the vector potential, which simplifies the application of the principle. The many-valued character of the scalar potential ensures that this description is equivalent to that using the vector potential. The nature of this many-valuedness is thoroughly investigated.

537.56

17013 COLLISION OF TWO PLASMA STREAMS.

W.E.Nexsen, Jr, W.F.Cummins, F.H.Coensgen and A.E.Sherman.
Phys. Rev., Vol. 119, No. 5, 1457-9 (Sept. 1, 1960).

It has been predicted that under certain conditions the counter-streaming of colliding plasma streams should be unstable and should be stopped in a very short distance with the translational energy being converted to the energy of ion or electron oscillations. The collision of two plasma streams satisfying one set of conditions, for which instability had been predicted, was studied experimentally, and no evidence in instability was observed. Study of the plasma dispersion equation indicates that much more rigorous conditions must be met before such instability should occur.

537.56

17014 DIFFUSION THROUGH A FINITE PLASMA IN A UNIFORM MAGNETIC FIELD. L.Tonks.

Phys. of Fluids, Vol. 3, No. 5, 758-64 (Sept.-Oct., 1960).

The anisotropic diffusion of ions and electrons in a nonmultiplying partially ionized plasma lying in a strong uniform magnetic field has been analysed to zero and first order in the parameter Ω^{-1}, where Ω^2 is the ratio of the reduction of transverse electron mobility to the reduction of transverse ion mobility due to the magnetic field. This obviates the need for an earlier erroneous assumption. Potential distribution and electron and ion current flows have been formulated for two-dimensional flow, using a lowest-harmonic charged-particle distribution in a rectangular space and various wall-current conditions. The encroachment of sheaths inward from the walls has not been considered on the basis that, in principle, the charged-particle concentration could always be assumed to be large enough to keep this complication small.

537.56

17015 EXPERIMENTAL INVESTIGATION OF THE DIFFUSION BREAK-UP OF A PLASMA IN A MAGNETIC FIELD.

V.E.Golant and A.P.Zhilinskii.
Zh. tekh. Fiz., Vol. 30, No. 7, 745-55 (July, 1960). In Russian.

The mechanism of the break-up of plasma in a helium-containing straight cylindrical tube furnished with an axial magnetic field was investigated by means of a very high-frequency method which enabled electron densities to be determined at various times after the arrival of an initiating pulse. The fundamental mechanism of the break-up was the diffusion of charged particles across the magnetic field. Helium pressures ranged from 0.09 to 2 mm mercury, the magnetic field from 0 to 1100 Oe, the particle concentration was $10^{8-11}/\text{cm}^3$. A.E.I. Research Laboratory

537.56

17016 DIFFUSION OF CHARGED PARTICLES ACROSS A MAGNETIC FIELD IN A THREE-COMPONENT PLASMA. V.E.Golant.

Zh. tekh. Fiz., Vol. 30, No. 8, 881-92 (Aug., 1960). In Russian.

Collisions with neutral atoms, generally omitted from earlier treatments, considerably affect the motion of charged particles in an electron—ion plasma. The present theory takes all three kinds of particle into account and determines the motion of the charged particles under the influence of concentration and temperature gradients, in particular providing expressions for electronic and ionic currents transverse to the magnetic field.

A.E.I. Research Laboratory

537.56

17017 INTERACTION BETWEEN COLD PLASMAS AND GUIDED ELECTROMAGNETIC WAVES.
S.J.Buchsbaum, L.Mower and S.C.Brown.
Phys. of Fluids, Vol. 3, No. 5, 806-19 (Sept.-Oct., 1960).

The microwave cavity method for the measurement of various parameters of a cold plasma in the presence of a static magnetic field is examined. Emphasis is placed on the determination of the limits of validity of the perturbation theory for various mode configurations of a cylindrical cavity coaxial with a plasma column and coaxial with the static magnetic field. The classes of modes examined are those which in the absence of the magnetic field reduce to the TM_{0m0}, TM_{1mn}, and TE_{1mn} modes. For the TM_{0m0} and TE_{0mn} modes, exact expressions for the cavity frequency shifts are obtained. These expressions are then expanded in approriate power series to obtain the limits of validity of the perturbation method. For the TE_{0mn} modes the perturbation theory must be modified to account for the polarization of the plasma. In the absence of a magnetic field, the TM_{1mn} as well as the TE_{1mn} modes are degenerate in their resonant frequencies. The presence of a magnetic field removes the degeneracy and causes the resonant frequency to be double-valued. An experimental test of the validity of the perturbation method can be had by comparing the two resonant frequencies. The relation is given between the characteristics of the various modes and the propagation of plane waves in infinite uniform plasmas.

537.56 : 621.372

17018 SCATTERING OF ELECTROMAGNETIC WAVES FROM AN INFINITELY LONG MAGNETIZED CYLINDRICAL PLASMA. P.M.Platzman and H.T.Ozaki.
J. appl. Phys., Vol. 31, No. 9, 1597-601 (Sept., 1960).

The magnetically contained plasma is characterized, in an average way, in terms of its macroscopic dielectric tensor. The problem of the scattering of plane electromagnetic waves from a uniform cylindrically symmetric plasma configuration is solved analytically. Numerical results for the uniform case are obtained and graphed for interesting ranges of the parameters involved. Possible applications of the results for use in investigating the plasma's properties are discussed.

537.56 : 621.317.44

17019 MAGNETIC PROBES OF HIGH FREQUENCY RESPONSE. S.E.Segre and J.E.Allen.
J. sci. Instrum., Vol. 37, No. 10, 369-71 (Oct., 1960).

Probes for the measurement of the magnetic field distribution in fast pulsed discharges were constructed. Frequency response was measured and agreed well with that calculated from an equivalent circuit. The probes described have an attenuation flat (to within 1%) up to 20 Mc/s. A criterion is given which states the optimum value for the impedance of the recording circuit.

537.56

17020 DIELECTRIC CONSTANT OF A DENSE ELECTRON GAS. T.Pradhan and P.Misra.
Phys. Rev., Vol. 119, No. 6, 1878-91 (Sept. 15, 1960).

The problem of absorption and dispersion of electromagnetic waves in a dense electron gas is treated semiclassically through the use of Boltzmann equation and Fermi—Dirac statistics. The singularity in the dispersion fromula is treated by the method of Van Kampen (Abstr, 3042 of 1956). Expressions for the dielectric constant and conductivity as functions of frequency are obtained for temperatures at and near absolute zero.

537.56

17021 SHOCK WAVE AND SOLITARY WAVE STRUCTURE IN A PLASMA. O.W.Greenberg and Y.M.Trève.
Phys. of Fluids, Vol. 3, No. 5, 769-85 (Sept.-Oct., 1960).

Plane steady shock waves and solitary waves in a hydrogen plasma without external magnetic fields are studied using a simple kinetic theory model to describe the plasma. This model uses a Mott—Smith distribution for the protons and a local Maxwellian distribution for the electrons. Charge separations occur inside the shock front because of the proton-electron mass difference. The proton and electron densities, and the electric field, have an oscillatory fine structure with characteristic length $\sim 10\ M\lambda_D$, where M is the Mach number and λ_D the Debye length, going through the shock. In these oscillations, the densities overshoot their final Rankine—Hugoniot condition values. The distance in which the oscillations decay to 1/e, which is taken as the shock width, is where λ is the mean free path in the unshocked gas, in the ran Mach numbers considered. There are no continuous solutions this model above Mach 2.19. The peak electric fields inside th shock are large; in a plasma of $\lambda/\lambda_D = 2 \times 10^4$, the electric fie reaches 2.2×10^6 V/cm in a Mach 2.1 shock. The large-amplit solitary waves, which are the basic ingredient of the fine struc of the shock, are studied separately, and a heuristic picture is presented of the growth of these solitary waves, which is due t coupling between the bulk flow of the plasma and the internal el fields generated by charge separation. The rate of decay of the solitary waves is estimated.

ELECTRON EMISSION
ELECTRON BEAMS

537.533 : 53

17022 CONTRIBUTIONS TO THE NINTH ALL-UNION CONFERENCE ON CATHODE ELECTRONICS.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 6, 629-722 (1960). In Russian.

This was held on 21-28 October 1959, in Moscow. Sixteen papers were presented, abstracts of which will be published (u the appropriate headings) in this or succeeding issues of "Scie Abstracts".

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17023 DETERMINATION OF THE ACTIVATION ENERGY FOR THE PROCESS OF STABILIZATION OF THE WORK FUNCTION OF THE GOLD-BARIUM SYSTEM.
E.D.Pavlovskaya, I.L.Sokol'skaya and Yu.G.Shishkin.
Fiz. tverdogo Tela, Vol. 2, No. 8, 1849-50 (Aug., 1960). In Rus

The work function, φ, of Au and Ba films, deposited on a strip, can be stabilized by heating. This effect has been attrib to the formation of an intermetallic compound AuBa. Since the time (t) necessary for φ to attain the stable value depends on t temperature (T), it has been inferred that the formation of Au requires a certain activation energy (E). A method of accurate measuring T has been developed which made it possible to dete that E = 0.8 ± 0.1 eV from the slope of the log 1/t versus $10^3/$ curve.

M.H.Sl

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17024 A THEORY OF NON-STATIONARY EMISSION OF SEMICONDUCTING THERMIONIC CATHODE. I. LINEAR APPROXIMATION. A.A.Ostroukhov and K.B.Tolpygo
Fiz. tverdogo Tela, Sbornik [Supplement] II, 215-23 (1959). In Russian.

A short review and criticism of the existing theories is fo by a new theory of non-stationary thermionic emission which a for the effect of an external field and current flow on the carri density in the surface layer. Formation of a negative surface charge, which screens the external field and reduces the electr density at the surface, is held to be responsible for the fall of thermionic current within 10^{-4} sec from application of a pulse to the cathode. A system of differential equations and boundar conditions describing the change of current with time is solved the linear approximation for the case of a weak external field. effect of various factors (such as properties of the semiconduc the anode voltage and temperature) on the form of the thermion current pulse is investigated.

A.Tybule

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17025 A THEORY OF NON-STATIONARY EMISSION OF SEMICONDUCTING THERMIONIC CATHODE. II.
A.A.Ostroukhov.
Fiz. tverdogo Tela, Sbornik [Supplement] II, 224-34 (1959). In Russian.

For Pt I see preceding abstract. The equations and bound conditions derived in Pt I for the carrier densities at the surfa and in the interior are solved for the non-linear case when the electron density in the interior follows the changes of the surf charge without any lag. The current-voltage characteristics o the cathode are found at the beginning and at the end of a semi-infinite anode voltage pulse, the dependence of the thermionic it on time is calculated, and the effect of the d.c. component anode current is discussed. The results obtained agree tively with the experimental data. A.Tybulewicz

37.533

26 DENSITY OF A THORIUM MONOLAYER FOR MAXIMUM THERMIONIC EMISSION.

anforth and D.L.Goldwater.
l. Phys., Vol. 31, No. 10, 1715-17 (Oct., 1960).

n investigation is described in which a high-sensitivity ana- l balance of standard design is used for determination of the e density of that thorium layer which corresponds to maximum ionic emission with the thorium-on-tungsten system. Follow- rattain and Becker's 1933 definition of this value of surface y as one "f unit," thorium vapour is allowed to accumulate on rtz plate unit a weighable number of f units (about 600) has deposited. The thorium flux in f units per minute is monitored dically by means of a tungsten filament diode during the course deposition. Two polycrystalline specimens of ribbon from me source have yielded the value of (4.2 ±0.2) 10^{14} atoms/cm^2 density for maximum emission. This is to be compared with e of 5.0×10^{14} atoms/cm^2 obtained in 1934 on theoretical ds by Langmuir.

537.533

027 ANOMALOUS THERMIONIC EMISSION FROM UC AND $(ZrC)_{0.8}\,(UC)_{0.2}$. G.C.Kuczynski.

l. Phys., Vol. 31, No. 8, 1500-1 (Aug., 1960).

nomalously large emission constants (Richardson equation) are which have been previously ascribed to relatively large inter- lic atom distances in carbide and boride lattices. By graphical sentation of earlier data it is found that they do not fit a simple rdson plot and deduction of anomalous constants cannot be made. G.F.J.Garlick

537.533

7028 PHOTOELECTRIC EMISSION FROM SOLID LAYERS OF ORGANIC DYES. F.I.Vilesov and A.N.Terenin.

Akad. Nauk SSSR, Vol. 133, No. 5, 1060-3 (Aug. 11, 1960). ssian.

For certain frequencies of incident radiation, dyes deposited r by vacuum evaporation or settling from solution exhibit ply increased photoelectric emission. The photoelectrons come o groups, the slower of which cannot satisfactorily be explained rlier theories. Agreement with experiment can be obtained by ming that some of the energy absorbed from incident quanta es positive ions and engenders intermolecular vibrations. A.E.I. Research Laboratory

537.533 : 539.2

7029 PHOTOEMISSION AND VALENCE BAND STRUCTURE OF ALKALI IODIDES. H.Philipp, E.A.Taft and L.Apker.

s. Rev., Vol. 120, No. 1, 49-51 (Oct. 1, 1960).

Energy distributions are described for external photoelectrons ted from CsI by photons of energy 11.3 eV. All but about 5% of photoelectrons emerge with kinetic energies between 1.5 and eV. The conspicuous lack of electrons at lower energies is rpreted in terms of a valence band of width about 3 or 4 eV with pper edge lying about 6 eV below the vacuum level. Related lts are mentioned for RbI, KI, NaI, CsBr, and CsCl.

537.533

7030 FIELD INDUCED PHOTOEMISSION AND HOT-ELECTRON EMISSION FROM GERMANIUM.

Simon and W.E.Spicer.
ppl. Phys., Vol. 31, No. 8, 1505-6 (Aug., 1960).

As in previous studies of silicon (Abstr. 2325 of 1958) photo- hot electron emission have been observed due to internal fields ermanium p--n junctions. Without a field the threshold energy ces to that of the band gap of germanium. The hot electron ssion and the photoemission show very similar dependence on age for lower values of the latter. G.F.J.Garlick

537.533 : 621.383.27

7031 CONTRIBUTION TO THE STUDY OF PHOTOMULTIPLIER CHARACTERISTICS. R.Chery and A.Perrin.

lear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 19 of 1960) p. 73-8. In French.

The photomultiplier studied was the French 53AVP. The first eriment described was designed to study the statistical pulse ctrum for single photoelectrons. The light source was weak enough to ensure time resolution of the photons, and background noise was reduced by cooling the photomultiplier. It was found that larger amplitude pulses were produced as the total voltage was increased from 1700 to 1750 V. This is attributed to a reduction of the variation of stage gain with increasing voltage. Cathode homogeneity was measured by means of a disk with a spiral of 1 mm holes; inhomogeneities of 10 to 25% were found. Variations of transit time were measured as a function of distance from the centre of the photocathode, and amounted to 3-4 mμsec. W.G.Stripp

537.533

17032 SECONDARY ELECTRON EMISSION OF SOME POLYMERS. T.L.Matskevich.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 277-81 (1959). In Russian.

Reports measurements of the secondary electron emission coefficient and the reflection coefficient of primary electrons with energies between 200 and 2400 eV incident on polytetrafluorethylene, polyethylene, polystyrene, 4-bromo-2-5-dimethylstyrene, 2-3-dichloro-4-5-dimethylstyrene and polyvinyl alcohol at temperatures between 20°C and the softening point of a given polymer. A.Tybulewicz

537.533

17033 ENERGY DISTRIBUTION OF SECONDARY ELECTRONS FROM INSULATORS. H.Deichsel and E.Reichert.

Z. Phys., Vol. 159, No. 4, 478-81 (1960). In German.

Diamond and NaCl (cleavage surface) were investigated using a primary electron beam density of 10^{-13} to 10^{-14} A/cm^2 and detecting single secondaries by an Allen-type multiplier. The maxima in the secondary spectra were at 1.7 and 1.6 eV for diamond and NaCl, respectively.

537.533 : 539.2 : 537.3

GENERATION OF E.M.F.'S IN LEAD SULPHIDE FILMS ON BOMBARDMENT WITH SLOW ELECTRONS. See Abstr.15897

537.533

17034 EXACT ELECTRODES FOR THE FORMATION OF A CURVED SPACE-CHARGE BEAM. II. R.J.Lomax.

J. Electronics and Control, Vol. 7, No. 6, 482-90 (Dec., 1959).

The analytical method of determining Pierce-electrodes shapes for curved space-charge beams which was given in an earlier paper (Abstr. 5050 of 1958) is extended by removing the requirement that explicit expressions are needed for the potential and field distributions along the edge of the beam. The Walker—Ivey solution for flow between inclined plane electrodes is used to demonstrate the technique when the potential and field are given only by differential equations which cannot be solved in closed form.

537.533 : 621.385.62

17035 MAGNETIC SYSTEM WITH AN INHOMOGENEOUS FIELD FOR THE EXPERIMENTAL INVESTIGATION OF ELECTRON TUBES. A.Ya.Sochnev.

Zh. tekh. Fiz., Vol. 30, No. 8, 933-7 (Aug., 1960). In Russian.

As a useful tool in investigating the sensitivity of electron tubes employing magnetic fields to inhomogeneities in these, a magnetic system providing deliberate inhomogeneities is required. Calculations are given for the construction of systems possessing large inhomogeneities of given form. In particular a system giving a parabolically changing axial magnetic field is designed. A.E.I.Research Laboratory

537.533 : 621.385.1

17036 PASSAGE OF CURRENT THROUGH THE GLASS ENVELOPE OF A RECEIVING-TYPE VALVE. H.N.Daglish.

Brit. J. appl. Phys., Vol. 11, No. 9, 440-5 (Sept., 1960).

In normal operation of receiving-type valves, with soda glass envelopes, a small current may flow through the glass to an external coating. Part of this current consists of positive ions generated by the flow of electrons through the atmosphere inside the envelope. As the pressure inside the valve falls during operation, the value of the ratio of the current through the envelope to the anode current flowing in the valve also falls, eventually reaching a stable value which is independent of pressure. This residual value is due to the emission of photoelectrons from the inside of the glass, when bombarded by X-rays generated at the anode. It therefore depends upon the nature of the anode surface and upon the anode potential. The continuous passage of this photoelectric current through the glass may generate small quantities of gas by electrolysis, and so affect the behaviour of the valve. Experimental evidence suggests that the risk of permanent damage to the cathode emission is very small.

537.533 : 621.385.833

17037 THE CALCULATION OF ELECTROSTATIC ELECTRON-GUN PERFORMANCE. M.R.Barber and K.F.Sanders.

J. Electronics and Control, Vol. 7, No. 6, 465-81 (Dec., 1959).

An automatic electron trajectory tracer was used to analyse four different high current density electron guns operated electrostatically.

537.533 : 621.385.833

17038 TRIODE PIERCE GUNS.

B.Meltzer.

J. Electronics and Control, Vol. 7, No. 6, 491-6 (Dec., 1959).

The range of application of high-perveance Pierce guns may be increased by converting them to triode and multi-triode systems. A method is given and its applications for valve design in general are pointed out.

537.533 : 621.385.833

17039 NON-LINEAR BEHAVIOUR OF A MODULATED ELECTRON BEAM IN THE PRESENCE OF A VELOCITY DISTRIBUTION. S.V.Yadavalli.

J. Electronics and Control, Vol. 8, No. 5, 365-75 (May, 1960).

A procedure based on the Boltzmann equation is given for evaluating the harmonic currents in an electron beam in the presence of a velocity distribution. Employing this method, the second harmonic current in a drifting (initially velocity modulated) beam possessing a velocity distribution is evaluated.

537.533

17040 IRON-CLAD MAGNETIC CYLINDRICAL LENSES WITH A PLANE OF ANTISYMMETRY.

S.Ya.Yavor and M.Silad'i.

Zh. tekh. Fiz., Vol. 30, No. 8, 927-32 (Aug., 1960). In Russian.

Earlier calculations of the field distribution and deflecting properties of magnetic cylindrical lenses formed from parallel conductors and possessing a plane of antisymmetry are extended to three analogous lenses furnished with iron pole-pieces. The theory is compared with experiment. In particular the position of the line images formed by such lenses is given as a function of ampere turns.

A.E.I. Research Laboratory

537.533 : 621.385.833

17041 NUMERICAL INVESTIGATION OF A RANGE OF UNI-POTENTIAL ELECTRON LENSES. J.Vine.

Brit. J. appl. Phys., Vol. 11, No. 9, 408-11 (Sept., 1960).

An electronic digital computer has been applied to the computation of focal lengths and spherical aberration constants of unipotential lenses, utilizing field data obtained from a resistance network analogue. Results obtained are presented in graphical form and shown to be in good agreement with published experimental results, but not, in the case of spherical aberration constants, with results based on analytical approximation to the axial potential distributions. The sources of error in the computations are discussed, and the accuracy of the results estimated.

537.533 : 539.1.07

AUTORADIOGRAPHY IN ELECTRON MICROSCOPY.
See Abstr. 15216

ION EMISSION . ION BEAMS

537.534 : 621.385.032.213.13

17042 EMISSION OF NEGATIVE IONS OF OXYGEN DURING THE ACTIVATION OF OXIDE-COATED CATHODES.

N.A.Surplice.

Brit. J. appl. Phys., Vol. 11, No. 9, 430-3 (Sept., 1960).

Oxide-coated cathodes have been used as ion sources in a simple mass spectrometer and have been found to emit atomic negative ions of oxygen during their activation at high temperatures (1150-1275° K). A retarding potential at the collector was used to separate the ions emitted by the cathode from the ions formed in the residual gas. Most of the oxygen ions from the cathode arrived at the collector with more energy than they could have obtained from the potential difference across the electron gun, and their number increased as the cathode became more active. The evidence suggests that the ions were formed by dissociation of the oxide coating, then diffused to the surface and were removed by positive ion bombardment. Such a process would leave oxygen vacancies in the oxide which would act as electron donors and increase its electron emission.

5

17043 SECONDARY POSITIVE ION-EMISSION FROM PLATINUM.

R.C.Bradley, A.Arking and D.S.Beers.

J. chem. Phys., Vol. 33, No. 3, 764-9 (Sept., 1960).

Mass analysis of the secondary particles ejected from Pt
faces by inert gas ion bombardment or by heating revealed spe
characteristic of the base metal, of certain bulk and surface
impurities, and of the bombarding beam (so-called "reflected"
The Pt^+ ions seemed to come directly from the substrate rathe
than from surface compounds. Their yields increased with ter
ture, bombarding ion energy, and bombarding ion mass. The r
of sputtered Pt ions to sputtered neutrals is estimated to be of
order of 1 to 1000 at room temperature. The kinetics of the
formation and desorption of a certain surface compound [possi
$Pt(CO)_2$] was studied by secondary ion analysis. The compou
formed spontaneously on the surface from the background gas in
instrument (CO at 10^{-8} mm Hg). Its formation rate was great
enhanced by inert gas ion bombardment. It desorbed readily a
1000° C with an activation energy of 0.74 ± 0.05 eV. The "refl
ions appeared to be sputtered rather than reflected. Their ene
was always extremely low (< 1 eV) and the dependence of thei
yield on ambient gas pressure and target temperature is consi
with the notion that they originated from inert gas atoms trapp
the surface layers.

5

17044 MASS SPECTROMETER INVESTIGATION OF SEC ARY POSITIVE AND NEGATIVE IONIC EMISSION, EXCITED BY THE BOMBARDMENT OF A MOLYBDENUM SU FACE BY POSITIVE IONS.

Ya.M.Fogel', R.P.Slabospitskii and I.M.Karnaukhov.

Zh. tekh. Fiz., Vol. 30, No. 7, 824-34 (July, 1960). In Russian.

Earlier work has secured a collective secondary emission
efficient including all the emitted ions. This is here refined in
order to separate the various factors governing secondary emi
The bombarding ions include Ne^+, A^+, and Kr^+, and the depend
of secondary emission on the energy of the primary particles
(5-40 keV) and target temperatures are determined. The dela
the emission of various ions after de-gassing are found.

A.E.I. Research Labo

537.534 : 621.38

17045 A PARAXIAL FORMULATION OF THE EQUATION SPACE-CHARGE FLOW IN A MAGNETIC FIELD.

P.T.Kirstein.

J. Electronics and Control, Vol. 8, No. 3, 207-25 (March, 1960

The equations for irrotational, axially symmetric, laminar
space-charge flow are set up in a paraxial manner. To this
approximation, the flow is specified by the magnetic field confi
tion, one trajectory, the potential along this trajectory, and the
variation of beam thickness. Any three of these quantities may
within certain limits, be specified arbitrarily, and the fourth th
computed by the formulae given. The method is directly applic
to flows in which the cathode is conical, and either the flow lin
not cut magnetic flux lines, or the magnetic field is tangential
cathode. Numerical results are given for a beam from a cylin
cathode, and extensions of the methods are discussed.

5

17046 THE INVESTIGATION OF THE POTENTIAL DISTRIBUTION IN A LAYER OF POSITIVE ION SP CHARGE. V.A.Ivanchenko and L.A.Sena.

Zh. tekh. Fiz., Vol. 30, No. 8, 964-70 (Aug., 1960). In Russian

Describes in detail a new method based on the analysis of
energy of ions moving in the layer. The results of measureme
carried out in Hg vapour agree with the calculation based on th
Langmuir equation.

J.M.Za

5

17047 NEGATIVE HYDROGEN AND DEUTERIUM ION BE

S.F.Philp.

J. appl. Phys., Vol. 31, No. 9, 1592-6 (Sept., 1960).

The charge state of a monoenergetic beam of hydrogen ato
and molecular ions traversing a hydrogen gas target has been
measured as a function of the energy of the beam and the thick
of the gas target. The yield of negative ions from protons has
maximum of 1.5% at 13 keV. From diatomic and triatomic mo
cular ions the maximum yields were 3.0% and 4.5% at 26 and 3
respectively. The experiments have also been performed with
deuterium ions traversing the hydrogen gas target. The deuter
results are almost identical with those of hydrogen if the energ
scale for the hydrogen data is multiplied by two.

537.534

048 MOTION OF CHARGED PARTICLES AND CHARGED DISKS THROUGH AN ELECTRON—ION BEAM.

sintsadze.

kh. Fiz., Vol. 30, No. 8, 913-19 (Aug., 1960). In Russian.

he loss of energy involved in the motion of charged particles h a relativistic electron—ion beam contained in an ideal uide is investigated. Expressions for the intensity of the nkov radiation so excited and for the associated continuous um are determined. This is repeated for bunches of particles essed into evenly charged disks (1) infinitely thin and (2) of thickness. The radius of the waveguide given maximum ion for a given frequency is found.

A.E.I. Research Laboratory

537.534

049 THE MASS-SPECTRUM LINE PROFILE AND THE ROLE OF A PULSE ION SOURCE IN THE RADIO-FREQUENCY -SPECTROMETER. E.M.Kuchkov.

kh. Fiz., Vol. 30, No. 5, 568-72 (May, 1960). In Russian.

quations governing the line profiles in a radio-frequency -spectrometer are presented hodographically, thus enabling rmance to be estimated quickly and easily. Comparison is between the behaviour of continuous and pulse ion sources.

A.E.I. Research Laboratory

537.534

050 A NEW DESIGN OF PULSE MAGNETIC MASS SPECTROMETER WITH HIGH RESOLVING POWER.

hustrov.

kh. Fiz., Vol. 30, No. 7, 860-4 (July, 1960). In Russian.

An improvement of the magnetic resonance mass spectrometer myrin and Shustrov (Abstr. 5815 of 1959). Harmonics are nated from the spectra by the use of a pulsed ion source, and pplication of a voltage pulse during the revolution of the ions to high resolving power together with an increase in the gent ion current.

J.E.Gore

537.534 : 539.12

7051 ENERGY LOSS OF HEAVY IONS IN NICKEL, OXYGEN, AND NUCLEAR EMULSION. P.G.Roll and F.E.Steigert.

ear Phys., Vol. 17, No. 1, 54-66 (June (2), 1960).

Range—energy relations for He^4, B^{10}, B^{11}, C^{12}, N^{14}, O^{16}, F^{19} and ions in gaseous oxygen and nickel foil were measured in the gy range 2 to 10 MeV per a.m.u. (atomic mass unit). Together similar relations for heavy ions in nuclear emulsions, reported earlier paper (Abstr. 11073 of 1960), these were differentiated erically to obtain specific energy loss relations. The effective ge of heavy ions passing through matter, as well as the relative ping power per atom of oxygen, nickel and emulsion, were com- d from these and compared with theoretical predictions. From comparison, it was concluded that fairly reliable calculations of ific energy losses and/or range—energy relations can be made various heavy ion species in different stopping media.

537.534 : 539.27

7052 ION-BOMBARDMENT ETCHING OF SYNTHETIC FIBERS. F.R.Anderson and V.F.Holland.

ppl. Phys., Vol. 31, No. 9, 1516-18 (Sept., 1960).

An ion-bombardment etching method was used to prepare hetic fibre-samples for study in the electron microscope. roducible results were obtained by bombardment in a con- tly changing argon atmosphere at a pressure of 1-2 cm Hg for min. The etch patterns produced by this method were charac- stic of the orientation of the fibre samples which were investi- d.

PARTICLE ACCELERATORS

537.54

7053 SPLITTING OF AN ELECTRON BEAM AT THE EXIT OF A LINEAR ACCELERATOR BY MEANS OF AN CTROMAGNETIC WAVE IN A GUIDE. A.I.Zӯkov.

tekh. Fiz., Vol. 30, No. 8, 971-4 (Aug., 1960). In Russian.

The successive bunches of electrons in the beam can be split assing them through a guide with a transverse electric field mode) whose frequency is half that of the bunch frequency and se phase velocity is twice that of the beam velocity.

J.K.Skwirzynski

537.54 : 621.384.621

17054 COMPACT 1.5 MeV ELECTROSTATIC ACCELERATOR. L.I.Pivovar, V.M.Tubaev and M.T.Novikov.

Zh. tekh. Fiz., Vol. 30, No. 1, 74-81 (Jan., 1960). In Russian. English translation in: Soviet Physics—Technical Physics (New York), Vol. 5, No. 1, 67-73 (July, 1960).

A description is given of the design of accelerating tubes and of an electrostatic accelerator, which operate in compressed gas; operational tests are also described. The accelerator is located in a tank 1400 mm high and 650 mm in diameter. The accelerator produces hydrogen ions with an energy of 1.55 MeV, and the potential gradient along the accelerating tube is approximately 2 MV/m.

537.54 : 539.12

17055 A VERY LOW VOLTAGE DEUTERON ACCELERATOR. R.Bilwes, R.Seltz, M.Suffert, M.Liess, J.J.Nehlig and D.Magnac-Valette.

J. Phys. Radium, Vol. 19, No. 2, 183-4 (Feb., 1958). In French.

An accelerator producing 1 mA of deuterons of up to 40 KeV energy.

S.J.Goldsack

537.54

17056 MODERNIZATION OF THE STOCKHOLM CYCLOTRON.

Nature (London), Vol. 187, 381 (July 30, 1960).

Attention is drawn to two papers (Abstr. 9122-3 of 1960) which describe changes made in the Stockholm fixed-frequency 225 cm cyclotron. A brief abstract of the papers is given.

C.F.Barnaby

537.54

17057 A RING CYCLOTRON WITH A VERTICALLY INCREASING MAGNETIC FIELD.

A.P.Fateev and B.N.Yablokov.

Atomnaya Energiya, Vol. 8, No. 6, 552-53 (1960). In Russian.

The ring cyclotron has a magnetic field increasing vertically as z^n and constant in time, with opposite signs in alternating sectors. A condition is derived for the stability of motion in a plane curve consisting of arcs of alternating curvature and straight sections. This condition is evaluated for $n \cong 10$, and a fairly wide range of stability is found. The possibility of stacking the particles by means of phase bunching is discussed.

J.B.Sykes

537.54

17058 SOME PROPERTIES OF ORBITS IN ACCELERATORS IN CONDITIONS OF SIMILARITY.

A.A.Kolomenskii and A.N.Lebedev.

Atomnaya Energiya, Vol. 8, No. 6, 553-5 (1960). In Russian.

The motion of particles in similarity conditions (betatron-oscillation mode-numbers independent of energy) is discussed, and the linearized equations of motion are solved for the non-resonance case. The damping of betatron and synchrotron oscillations in similarity conditions for orbits of variable curvature is shown to be given by the same formulae as in ordinary weak-focusing and strong-focusing synchrotrons, so that damping cannot be based on coupling of radial and synchrotron oscillations; an artificial coupling with vertical oscillations is necessary, and a longitudinal field about 10% of the guiding field is found to be suitable.

J.B.Sykes

537.54

17059 VARIABLE-SLOPE PULSE LINE FOR SYNCHROTRON INJECTOR. D.K.Wells and R.Johnson.

Rev. sci. Instrum., Vol. 31, No. 9, 942-3 (Sept., 1960).

An injector pulse-forming network for the 300 MeV synchrotron at the University of California has been developed which can be adjusted to produce a pulse to match the acceptance energy of the machine at any energy. This device and a method to determine the acceptance energy curve are described.

537.54 : 539.12

HIGH ENERGY PARTICLE RESEARCH WITH THE SYNCHRO-CYCLOTRON OF THE LABORATORY OF NUCLEAR PROBLEMS AT THE JOINT INSTITUTE OF NUCLEAR STUDIES. See Abstr. 15305

537.54

17060 SHAPING OF THE PHASE MOTION OF PARTICLES IN A SYNCHROPHASOTRON USING THE SYSTEM OF INERTIAL SYNCHRONISATION OF THE FREQUENCY-MODULATED GENERATOR. A.A.Vasil'ev.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 345-8 (July 11, 1960). In Russian.

An analysis of the behaviour of the system is given, and some possible applications are discussed.

J.E.Gore

537.54

17061 A NEW METHOD OF INVESTIGATING THE PROCESS OF INJECTION OF ELECTRONS IN THE BETATRON.
A.P.Komar, G.F.Mikheev, V.P.Fominenko and N.N.Chernov.
Zh. tekh. Fiz., Vol. 30, No. 7, 855-9 (July, 1960). In Russian.

With the normal form of injector, resonance of the electrons is achieved over a finite range of orbits. The method here described allows electrons to be injected only for a single, arbitrarily chosen orbit, and hence facilitates investigation of the injection process.

A.E.I. Research Laboratory

537.54

17062 MODEL OF A CYLINDRICAL BETATRON WITHOUT IRON. Yu.S.Korobochko and K.S.Shilkov.
Zh. tekh. Fiz., Vol. 30, No. 8, 981-3 (Aug., 1960). In Russian.

A description is given of a working model, in which a homogeneous magnetic field is provided by solenoids inside and outside the evacuated accelerator chamber. Annular quartz plates covered with a conducting layer are used as deflectors to give axial focusing. The authors claim a considerable increase in intensity over iron-containing systems. J.E.Gore

MAGNETISM

(The magnetic properties of solids are included under Solid-State Physics; similarly for Liquid State and Gaseous State)

538

17063 HIGH MAGNETIC FIELD RESEARCH. H.P.Furth.
Science, Vol. 132, 387-93 (Aug. 12, 1960).

Review article. Deals with field production methods and considers various applications in current research, including, thermonuclear fusion, particle accelerators and interactions with field regions inside matter such as high-field Zeeman effect and magnetic resonances.

538.1 : 621.318.381

17064 HIGH PERFORMANCE LABORATORY ELECTROMAGNET. L.Nowicki.
Acta phys. Polon., Vol. 18, No. 5, 531-4 (1959).

Describes briefly the construction and performance of a water-cooled electromagnet with adjustable gap, suitable for radiospectroscopy. The magnet produces a 6 kOe field in a 4 cm gap between the 10 cm diameter poles. D.J.Truslove

538.1 : 537.59

MODEL EXPERIMENTS ON THE DESIGN OF SOLID IRON MAGNETS FOR USE IN COSMIC RAY SPECTROGRAPHS.
See Abstr. 15462

538.1 : 537.59

THE CHARACTERISTICS OF A SOLID IRON MAGNET FOR USE IN A COSMIC RAY SPECTROGRAPH. See Abstr. 15463

538.1 : 621.318.381

17065 PRODUCTION OF A PULSED MAGNETIC FIELD USING AN ELECTROLYTIC CAPACITOR BANK.
D.G.Bate and R.F.Saxe.
J. sci. Instrum., Vol. 37, No. 10, 378-81 (Oct., 1960).

An economical system for obtaining magnetic fields of the order of 10^4 G lasting for times of the order of milliseconds is described. A switch is operated by a falling mercury column and performs two switching operations separated by an adjustable, repeatable delay of a few milliseconds. Currents of the order of 10^4 A flow through the switch during operation. The source of stored energy is a capacitor bank of large capacitance and low voltage, and this is discharged through a solenoid by means of the switch.

538.1

17066 PRODUCTION OF A UNIFORM MAGNETIC FIELD BY MEANS OF AN END-CORRECTED SOLENOID.
M.E.Gardner, J.A.Jungerman, P.G.Lichtenstein and C.G.Patten.
Rev. sci. Instrum., Vol. 31, No. 9, 929-34 (Sept., 1960).

Calculations and experimental technique are discussed. The field was trimmed to be uniform to 0.01% in an axial region comprising 63% of the solenoid at maximum field strength of 480 G.

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

17067 LABORATORY EXPERIMENTS IN MOTIONAL ELECTRIC FIELDS. J.W.Then.
Amer. J. Phys., Vol. 28, No. 6, 557-9 (Sept., 1960).

The problem of unambigously demonstrating motional elec
fields to students is discussed and effective ways of achieving
are described. The principle involved in each case was the rot
of a conducting disk or cylinder in a fixed magnetic field.

C.F.B

5

17068 THE MECHANICAL STRESSES IN FIXED AND IN ROTATING CYLINDERS CARRYING A UNIFORM ELECTRIC CURRENT. A.A.Kuznetsov.
Zh. tekh. Fiz., Vol. 30, No. 5, 589-91 (May, 1960). In Russian.

The electromagnetic radial compressive force per unit vol
on a long fixed conductor of radius r carrying a current of dens
j is $R_j = -kj^2r$, where k depends only on the system of units. T
solution of the problem of a rotating cylinder with an inertial f
per unit volume, which is a linear function of the radius r. is f
from the theory of elasticity. Expressions are thus obtained d
for the components of mechanical stress in the case of a condu
The case of a rotating cylinder simply requires subtraction of
electromagnetic from the inertial force; when the two forces b
there will be no pressure, e.g , in a liquid rod. D.E.

538.3 : 621.3.013 : 621

17069 ELECTROMAGNETIC FIELD OF A FERROMAGNE TRANSFORMER. V.Bevc.
Amer. J. Phys., Vol. 28, No. 7, 637-8 (Oct., 1960).

It is pointed out that oversimplified pictures of ferromagn
transformers are not satisfactory from the view point of Maxw
equations. A simple one-dimensional solution for the electrom
netic field of an ideal ferromagnetic core consistent with the fi
equations is presented The author suggests that only such fie
be used in introductory courses.

538.3 : 621

17070 ON THE LOSS DUE TO EDDY CURRENTS IN A CYLINDRICAL CORE, IN THE QUASI-STATIONAR STATE. O.Beaufays.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 45, No. 11, 1078-83 (1
In French.

A general formula is derived for the energy loss due to ed
currents in a long cylindrical core of arbitrary cross-section,
sinusoidal magnetic field parallel to the axis of the cylinder.

H.Mo

538.3 : 621

17071 THE MECHANICAL STRESSES DUE TO RADIAL ELECTROMAGNETIC FORCES IN A MULTILAYE COIL CARRYING A UNIFORM CURRENT, WITH RECTANGUL CROSS-SECTION OF THE WINDING-CONDUCTOR. A.A.Kuzn
Zh. tekh. Fiz., Vol. 30, No. 5, 592-7 (May, 1960). In Russian.

Only the radial electromagnetic force is taken into accoun
since this is the cause of rupture stresses in the central windi
The thickness of the insulation between turns is neglected for
licity, i.e. the filling factor is 1. The expressions obtained fo
radial and tangential stresses σ are applied to Cockcroft's nu
ical example (Abstr. 3114 of 1928), giving $(\sigma_r)_{max} = 400$ kg/cm^2
$(\sigma_t)_{max} = 8100$ kg/cm^2, in agreement with the familiar fact that
$(\sigma_t)_{max} > (\sigma_r)_{max}$. Cockcroft's mistake in neglecting σ_t, in integ
of $d/dr(r\sigma_r) - \sigma_t + rR = 0$, is pointed out. D.E.

17072 A FIELD REPRESENTATION OF ELECTROMAGN RADIATION. A.Papapetrou.
C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 4292-4 (June 27, 196
In French.

The solution of the Maxwell—Lorentz equation for electrom
radiation can be written as a superposition of plane waves. It
shown that this field essentially depends on two independent w
functions. J.K.Skwir

538.3

073

AN INTEGRATION OF THE UNIFIED EQUATION OF THE ELECTROMAGNETIC FIELD BY MEANS OF THE IC GREEN FUNCTION.

Chen To Tai.

cad. Brasil. Cienc., Vol. 31, No. 4, 511-14 (1959).
rtuguese.

unified equation, representing a compact form of Maxwell's ions, was integrated by means of the dyadic Green function. esult is suitable for the description of boundary problems. A se expression is obtained for Huygens' principle.

L.Pincherle

538.3

'074

STUDY OF THE SINGULAR ELECTROMAGNETIC FIELD IN MINKOWSKI SPACE.

M.Cahen.

Acad. Roy. Belgique Cl. Sci., Vol. 46, No. 2, 61-9 (1960).
ench.

Maxwell's equations for the singular case are written in spinor and the conditions of integrability discussed. The equations fied by the field of isotropic vectors associated with the ilar Maxwell field are obtained.

H.Morrison

538.3

'075

CONCERNING THE CLASSICAL INTERACTION OF AN ELECTRIC CHARGE WITH A MAGNETIC MONOPOLE.

deau.

r. J. Phys., Vol. 28, No. 6, 566 (Sept., 1960).

Trajectory of a charged particle in the field of a magnetic pole is derived by vector methods; the trajectory lies on the ace of a right circular cone.

J.K.Skwirzynski

538.3

7076

ON THE MOTION OF A CHARGED PARTICLE IN AN INHOMOGENEOUS MAGNETIC FIELD.

H.C.Brinkman.

ica, Vol. 25, No. 10, 1016-20 (Oct., 1959).

The motion of a charged particle in an inhomogeneous magnetic is treated, employing Hellwig's (see Abstr. 9364 of 1955) and kal's (1957) expansion of the gyration of the particle in a ier series. The relation of various constants of motion, the gy of the particle, Kruskal's action integral and Hellwig's er-order correction of the magnetic moment of the particle, is ussed.

538.3

7077

ELECTRODYNAMICS OF THE IMAGE FORCE.

F.Ollendorff.

h. Elektrotech. (Berlin), Vol. 45, No. 3, 169-87 (1960).
erman.

The main purpose of this work is to show classically that a e rigorous discussion of the normal image force ideas appears e possible. Different image forces are suggested for emission absorption processes when the boundary between a vacuum and emiconductor is considered. There are no references to earlier k.

P.T.Landsberg

538.3

17078

MAGNETOHYDRODYNAMICS.

S.Chandrasekhar.

ntiers of numerical mathematics symposium, Wisconsin, 1959
Abstr. 12232 of 1960) Paper Seven, p. 99-103

Three unsolved problems are stated, and each is briefly cussed.

H.N.V.Temperley

538.3

17079

THE TURBULENT REGIME OF OPERATION OF AN ELECTROMAGNETIC INDUCTION PUMP.

Lielpeter [J.Lielpēteris].

v. PSR Zinat. Akad. Vestis, No. 1(150), 81-8(1960). In Russian.

A theoretical criterion is derived for the turbulent flow in induction pump to be unaffected by the magnetic field. A method calculating the net flow in a given load, when the criterion is isfied, is given. An experiment to test this theory is described. om the good agreement between theory and experiment it is cluded that (1) the average electromagnetic force in the pump determined by the average flow velocity; (2) the magnetic field s not influence the frictional pressure loss inside the pump.

O.Penrose

538.3

17080

SOME AXIALLY SYMMETRIC STATIONARY MAGNETODYNAMIC MOTIONS OF AN ELECTRICALLY CONCTING GRAVITATING COMPRESSIBLE FLUID MASS.

T.Zeuli.

Accad. Sci. Torino I, Vol. 94, No. 4a, 533-51 (1959-60).
talian.

Agostinelli's results for a rotating fluid mass are extended to include the case of meridional motions, the magnetic and velocity fields being expressed in terms of two arbitrary functions. The magnetohydrodynamic equations reduce to a single 4th order partial differential equation for a special choice of the arbitrary functions in the case of a non-rotating spheroidal mass in slow adiabatic motion when the magnetic field is weak and confined to meridian planes.

R.A.Newing

538.3

17081

SOME QUESTIONS OF STATIONARY FLOW OF A CONDUCTING FLUID IN AN INFINITELY LONG ANNULAR TUBE IN THE PRESENCE OF A RADIAL MAGNETIC FIELD.

I. B.Chekmarev.

Zh. tekh. Fiz., Vol. 30, No. 6, 601-5 (June, 1960). In Russian.

Exact solutions of the magnetohydrodynamic equations are obtained for three special types of steady flow of an incompressible viscous imperfectly conducting fluid between two porous coaxial cylinders. Three cases are considered, in each of which just one of V_r, V_z, V_ϕ is made to vanish.

O.Penrose

538.3

17082

HYDROMAGNETIC PLANE STEADY FLOW IN COMPRESSIBLE IONIZED GASES.

Y.Kato and T.Taniuti.

Progr. theor. Phys., Vol. 21, No. 4, 606-12 (April, 1959).

The magnetohydrodynamics in compressible gases of infinite conductivity is discussed under the assumptions that the flow is isentropic and steady and that the directions of flow velocity and of magnetic field are in the same plane. The hyperbolicity conditions for the starting equations, under which the discontinuity surfaces can appear, are investigated. The special case in which the flow is parallel to the direction of magnetic field is analysed in detail.

538.3

17083

NONSTATIONARY FLOW OF INCOMPRESSIBLE, VISCOUS AND CONDUCTING FLUID IN THE PRESENCE OF TRANSVERSE MAGNETIC FIELD.

I.B.Chekmarev.

Zh. tekh. Fiz., Vol. 30, No. 8, 920-4 (Aug., 1960). In Russian.

Considers the motion of a conductive fluid in the half-space over an infinite moving plate (which is infinitely thin). The half-space below the plate is filled with a stationary solid conductor. The magnetic field is transverse to the direction of motion of the plate. The functions determining the motion are found by means of the Laplace Transforms for an arbitrary motion of the plate. Closed form solutions are obtained for uniform and for oscillatory motions when some system parameters have particular values.

J.K.Skwirzynski

538.3

17084

FLOW OF A CONDUCTING FLUID ROUND A SPHERE IN STRONG MAGNETIC FIELD.

G.É.Gershuni and E.M.Zhukovitskii.

Zh. tekh. Fiz., Vol. 30, No. 8, 925-6 (Aug., 1960). In Russian.

Obtains an approximate formula for the resistance force F of the sphere, valid for small values of Reynold's Number:

$$F = \frac{8\pi}{3}\sqrt{\sigma\eta}\,H_0 R^2 \frac{u}{c},$$

where σ and η are respectively the conductivity and viscosity of the fluid, H_0 is the magnetic field intensity parallel to the fluid velocity u, R is the radius of the sphere and c is the velocity of light.

J.K.Skwirzynski

538.3

17085

A NOTE ON MAGNETOHYDRODYNAMICS OF A FINITE ROTATING DISK.

S.K.Majumdar.

Z. angew. Math. Phys., Vol. 10, No. 4, 387-9 (1958).

The problem considered is the steady rotation of a finite disk in an electrically conducting liquid in the presence of a magnetic field along the axis of rotation. It is shown that the radial component of H is always small compared with the axial component if the depth of liquid is small compared with the radius of the disk.

H.N.V.Temperley

538.3

17086

HYDROMAGNETIC STABILITY OF FORCE-FREE TOROIDAL FIELDS.

J.L.Johnson.

Phys. of Fluids, Vol. 3, No. 4, 658-9 (July-Aug., 1960).

Stellarators can be made hydrodynamically stable during the ohmic heating phase when the pressure is zero. Curvature does not affect the stability criteria that are known for a large class of equilibria in which small multipolar fields and axial currents distort a zero-pressure plasma in a uniform axial field.

J.G.Oldroyd

538.3

17087 PARTICLE DIFFUSION ACROSS A MAGNETIC FIELD.
L.Spitzer, Jr.

Phys. of Fluids, Vol. 3, No. 4, 659-61 (July-Aug., 1960).

A possible mechanism by which the gyrating particles in a plasma in a stellarator manage to cross the magnetic field B, is discussed. Fluctuations in the electric field must be primarily responsible for the diffusion. It is shown, with some simplifying assumptions, that the coefficient of diffusion D for positive ions is given by $D = 2K_1^2K_2K_3(ckT/eB)$ where kT is the spread of particle energies, e/c the electronic charge in e.m.u., and K_1, K_2, K_3 are unknown constants. The value of $2K_1^2K_2K_3$ given by Bohm for transverse diffusion is $^1/_{32}$ but it may be computed from observational data on a stellarator. The validity of the simplifying assumptions is discussed. S.Weintroub

538.3

17088 RADIATION OF HYDROMAGNETIC WAVES.
R.Karplus.

Phys. of Fluids, Vol. 3, No. 5, 800-5 (Sept.-Oct., 1960).

The dyadic Green's function for hydromagnetic waves in a uniform, fully ionized, perfectly conducting, pressurless fluid is obtained. The electromagnetic field consists of two modes, one that propagates isotropically and that propagates along the field lines. The radiation rate from some simple model current distributions is derived from the Green's functions. If the source contains a current along the constant static field, then the radiation along the field lines through the source is very intense. This last result also holds in the nonuniform static field of an infinitely long straight wire.

538.3

17089 HYDROMAGNETIC RESONATORS.
R.Gajewski and O.K.Mawardi.

Phys. of Fluids, Vol. 3, No. 5, 820-8 (Sept.-Oct., 1960).

The behaviour of hydromagnetic waves in a cylindrical resonator of arbitrary cross-section is examined. The conducting fluid inside the resonator is permeated with a steady uniform magnetic field parallel to the generators of the cylinder. The equation describing the eigenfrequency spectrum is derived for all possible modes and types of waves. It is shown that a transverse longitudinal acoustic type wave when reflected from a rigid conducting termination generates an accompanying transverse longitudinal magnetohydrodynamic type wave and vice versa. Energy losses due to the finite viscosity and electrical conductivity of the fluid as well as to the finite conductivity of the walls were estimated for the case of purely transverse type waves. A Q factor for purely transverse type waves was subsequently calculated.

538.3 : 523.85

17090 THE MAGNETIC AND DYNAMICAL FIELDS OUTSIDE
A PROTO-STAR. L.Mestel.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 223-48 (1959).

A contracting proto-star formed in a magnetic cloud conserves its magnetic flux provided the plasma density does not become too low. The structure of the external field is studied, together with its effect on the flow of matter. Centrifugal force is assumed always negligible, and the star is supposed at rest in the cloud. The fields in the star and at infinity are both taken as uniform, and the flow is assumed isothermal. Possible equilibrium fields include: (i) A poloidal field, with all the lines of force extending to infinity, but with a small toroidal component strong enough to keep the centrifugal field small in spite of the inflow of matter. The field is weak at the equator, but the lines of force make sharp hairpin bends there, yielding a pinched equatorial discharge. (ii) A poloidal field, with some of the stellar field lines finite, separated by a ring of X-type neutral points from the infinite field lines, which have a structure similar to field (i). (iii) A twisted, torque-free, and approximately force-free field confined within a finite surface S, and an approximately curl-free field beyond S. If the cloud field initially contains toroidal flux threading poloidal loops, then type (iii) will result; otherwise, types (i) and (ii) are the relevant equilibrium fields, applying respectively to earlier and later stages in the star's contraction. The presence of the field alters the accretion problem somewhat. Solutions exist with supersonic and subsonic velocities at infinity, yielding respectively an increased or diminished accretion rate. In the absence of an external strong pressure field at infinity, the system is likely to approach the state with the lower rate, so that the presence of the field reduces the accretion rate substantially below Bondi's value.

17091 A NOTE ON THE MAGNETIC BRAKING OF A
ROTATING STAR. L.Mestel.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 3, 249-54 (1959).

A poloidal magnetic field connecting a rapidly rotating star
a slowly rotating envelope will be twisted so that it transports
angular momentum across the intermediate region of low densi
The field exerts equal and opposite torques on the star and env
In the intermediate region the field will probably not exert stro
compressive forces, but will be approximately force-free. By
trast with the completely force-free fields of the preceding abs
which cannot be generated by distortion of a poloidal field, ther
no toroidal flux linking a poloidal loop, and current does not flo
the same sense at every point of a loop.

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56 : 621.37

17092 FIELD MEASUREMENTS IN RESONANT CAVITIES
D.K.Callebaut and M.C.Vanwormhoudt.

Physica, Vol. 26, No. 4, 255-8 (April, 1960).

The percentage shift of the resonant frequency of a cavity,
perturbed by a small metallic body at a point of zero magnetic
is proportional to the volume of the perturbing body, and to the
square of the normalized unperturbed electric field. It is show
that the proportionality factor is only dependent upon the shape
the body and upon the orientation of the field. When the perturb
object is a small cylinder having its axis parallel to the field, i
be a function of α, the ratio of the height to the radius of the cy
The knowledge of this dependence allows the electric field to be
determined from a single perturbation measurement. The func
has been determined experimentally and happens to be fairly li
for cylinders which are not too high compared with their radius

5

17093 ELECTROMAGNETIC WAVES IN AN INTRODUCTO
PHYSICS COURSE. H.Y.Carr and R.L.Sells.

Amer. J. Phys., Vol. 28, No. 8, 727-32 (Nov., 1960).

The properties of plane electromagnetic waves are deriv
without the use of calculus in a manner which provides a funda
understanding of isolated waves far removed from their source
any guiding conductors. The symmetrical relationship of the
induced electric field to the induced magnetic field and the role
the displacement current are clearly demonstrated. Expressio
for the velocity of the wave and the magnitudes and directions
the fields are derived. These results are developed directly fr
basic induced field concepts, thus avoiding the complications
arising in the traditional transmission line approach which of n
sity involves free charges and conduction currents.

5

17094 INDUCED AND SPONTANEOUS EMISSION IN A
COHERENT FIELD. III. I.R.Senitzky.

Phys. Rev., Vol. 119, No. 6, 1807-15 (Sept. 15, 1960).

The theory developed in Pt I and II (Abstr. 474, 13508 of 1
dealing with the interaction between the electromagnetic field i
cavity resonator and a number of two-level molecules, is gene
to include a Gaussian spread in the molecular frequency. The
of the molecular frequency distribution coincides with the cavit
resonant frequency. There is a coherent driving field in the ca
at the same frequency, and cavity loss is taken into account. U
the formalism previously developed for a quantum-mechanical
in a lossy cavity, expressions are obtained by means of second
perturbation theory for the expectation values of the field stren
and field energy in the cavity, and of the power loss by the mol
It is shown that the parts of the field energy resulting from ind
and spontaneous emission, respectively, initially increase as t
square of the time and approach steady-state values after (diff
in general) transient periods, each of which is determined by t
time constants; cavity relaxation time and inverse molecular f
spread. It is also shown that both the induced and spontaneous
emission power radiated by the molecules increase initially lin
with the time and approach steady-state values after transient
For the induced emission power, the transient period is determ
by only one time constant, the inverse molecular frequency spr

for the spontaneous emission power it is determined both by erse molecular frequency spread and the cavity relaxation time. atio of induced to spontaneous emission is initially n, and aches a steady-state value

$$n[\exp(r^2)(1 - \text{erf } r)]^{-1},$$

n is the driving field energy in units of the photon energy, and e ratio of the cavity resonance width to molecular frequency d. The seeming inconsistency of this value with the classical of the ratio of the Einstein coefficients is discussed.

538.56 : 621.375.9

095 **SOME CHARACTERISTICS OF A MASER AT 1420 MHz.**
B.Bölger, B.J.Robinson and J.Ubbink.

ca, Vol. 26, No. 1, 1-18 (Jan., 1960).

regenerative solid-state maser has been constructed for Mc/s using 0.05% Cr^{+++} in K$_3$Co(CN)$_6$ and a pump frequency 50 Mc/s. With a magnetic field of 480 Oe at 11° to the alline a-axis in the ac-plane, the 1-2 transition was used for gnal frequency and the 1-3 transition for the pump frequency, ering the levels in order of increasing energy. The product ltage gain and bandwidth was 2.7×10^6 s^{-1}. Weaker emission bserved for several other transitions. For ruby (Cr^{+++} in) emission could be produced for the 2-3 transition at 1420 Mc/s the 1-3 transition pumped at 8500 Mc/s; for the 1-2 transition 20 Mc/s in ruby, with the 1-3 transition pumped at 10700 Mc/s a short pulse of emission could be produced. The emission for $^+$ in K$_3$Co(CN)$_6$ was found to be much higher when the pump extended throughout the crystal than when it had a node within rystal. This observation suggests that in K$_3$Cr(CN)$_6$/K$_3$Co(CN)$_6$ honon saturation mechanism proposed by Strandberg (Abstr. of 1957) does not take place.

538.56

7096 **A MASER WITH DOUBLE NUCLEAR RESONANCE.**
H.Benoit, P.Grivet, L.Guibe and M.Sauzade.

hys. Radium, Vol. 19, No. 11, 905-9 (Nov., 1958). In French.

The homogeneity of a Beaudouin electromagnet with 20 cm pole es and 40 mm gap was improved by using a system of Primas— hard circular currents which produced an average homogeneity 01 G on a few cm^3. The frequency of an autodyne oscillator was hronized on a magnetic resonance signal obtained in the field checked by comparison with a Wang spectrometer in quadrupole nance. It appeared that the synchronization of the auto-oscilla- on a paramagnetic absorption frequency could be obtained only ugh a complicated system of automatic control of the excita- frequency to the signal intensity. An emitted signal of the er type was obtained by use of a liquid (water in practice) , where the macroscopic magnetic moment of protons has been ed by a fast passage excitation. This last condition is realized e motion of the water in a region where both an inhomogeneous c field and a strong r.f. field exist (corresponding to the ave- value of the static field): speed of water 50 cm/sec, flipping field 3 G at 28.7 Mc/s; measuring frequency 29.4 Mc/s.

538.56 : 621.375.9

7097 **SOME POSSIBLE ARRANGEMENTS OF PARAMETRIC AMPLIFIERS EMPLOYING LOWER FREQUENCY**
MPING. N.B.Chakrabarti and K.D.Dikshit.

an J. Phys., Vol. 33, No. 10, 431-51 (Oct., 1959).

An analysis of certain parametric amplifiers using lower uency pumping in lumped constant circuits is presented. Two es (i) combination of a mixer and an amplifier using one pump two idlers and (ii) combination of a mixer and an amplifier g two pumps and two idlers, have been treated in detail. The se and power relations at signal frequency, pump and idling uencies have been discussed. The expressions for negative stance, gain, bandwidth and noise figure for each case have derived. Two other possible cases have been mentioned. It is wn that the multi-idler circuits offer no added advantage.

538.56

7098 **MEGAVOLT ELECTRONICS CERENKOV COUPLER FOR THE PRODUCTION OF MILLIMETER AND SUBMILLI-**
TER WAVES. P.D.Coleman and C.Enderby.

pl. Phys., Vol. 31, No. 9, 1695-6 (Sept., 1960).

The megavolt electron beam from a 10 cm "rebatron" was ed through an axial hole in a dielectric cone. This was designed at the Cherenkov radiation could be collected by a coaxial horn. pointed out that with a bunched beam appreciable microwave power should be obtained. This is confirmed by the experiment. A power of 0.3 W was obtained at the 13th harmonic (8 mm band).

D.Walsh

538.56

17099 **REVERBERATION-CHAMBER MEASURING TECHNIQUE AND THE CONSTRUCTION OF A LARGE REVERBERATION CHAMBER FOR ELECTROMAGNETIC WAVES.**

E.Meyer, H.W.Helberg and S.Vogel.

Z. angew. Phys., Vol. 12, No. 8, 337-46 (Aug., 1960). In German.

The decay time of reverberation in a closed chamber ("echo-box") is used to give a measure of the absorption properties of materials placed in the chamber. Success with a small model led to the construction of a chamber made of concrete 30 cms thick and having a volume of 338 m^3. The walls were covered with copper foil. Results are given of experiments with 3 cm radio waves.

V.G.Welsby

538.56 : 621.391.812.63

17100 **REFLECTION OF MICRO-WAVES FROM EARTH'S SURFACE.** A.C.De.

Indian J. Meteorol. Geophys., Vol. 11, No. 1, 45-9 (Jan., 1960).

Interesting examples of coefficient of reflection from flat ground (aerodrome runway) are described. These observations indicate the satisfactory performance of the radar set installed at Dum Dum airport for meteorological purposes. Different aspects of the occurrence of reflection phenomenon are discussed and a review of work in other countries is also made.

538.56

17101 **PENETRATION OF MICROWAVES INTO THE RARER MEDIUM IN TOTAL REFLECTION.**

J.J.Brady, R.O.Brick and M.D.Pearson.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1080-4 (Nov., 1960).

When the hypotenuse surfaces of two 45°—45°—90° prisms are separated by a narrow air gap, part of the electromagnetic radiation incident on the prisms will be transmitted through both prisms and part will be internally reflected in the first prism. Theory indicates that for prisms of index of refraction, $n = \sqrt{3}$, the transmission coefficient for the electric vector parallel to the plane of incidence ($T_{\parallel}$) varies as a function of the ratio of gap distance to wavelength, d/λ, the same as for the case of the electric vector perpendicular to the plane of incidence ($T_{\parallel}$). For $n < \sqrt{3}$, $T_{\parallel}$ falls off more slowly with d/λ than $T_{\perp}$. For $n > \sqrt{3}$, $T_{\parallel}$ falls off more rapidly with d/λ than $T_{\perp}$ Transmission and reflection coefficients were measured experimentally as a function of d/λ for 3-cm waves with prisms made of paraffin, sulphur, and sodium chloride.

538.56

17102 **THE PROPAGATION OF AN ELECTROMAGNETIC WAVE IN A FERROMAGNETIC.** L.G.Ipatov.

Zh. tekh. Fiz., Vol. 30, No. 5, 522-8 (May, 1960). In Russian.

A general mathematical theory of the propagation of electromagnetic waves in a large sheet of a badly conducting ferromagnetic is developed. It is shown that the magnetic field strength, the wave propagation constant, the magnetic permeability, the phase difference between induction and field, and the energy loss, depend not only on the hysteresis and eddy currents but also on the amplitude of the waves. In special cases the values obtained degenerate to those found by Cauer (1925), Becker (1939) and Arkadiev (1936). Graphs relating to nickel and Permindur are shown and found to support the theory. See Cauer (Abstr. 507B of 1926; Arch. Electrotech (Berlin), Vol. 15, 308-19, Dec. 5, 1925); also Becker and Doring, (Ferromagnetismus, 1939); Arkadiev, (Electromagnetic Processes in Metals, Vol. 2, 1936).

N.Davy

538.56

17103 **APERTURE FIELDS IN THE DIFFRACTION BY A SLIT.** Hwei-Piao Hsu.

J. appl. Phys., Vol. 31, No. 10, 1742-6 (Oct., 1960).

Aperture fields in the diffraction by a slit was studied numerically and experimentally. Numerical calculations are based on the exact solution in the form of an infinite series of Mathieu functions. Experimental measurements, by means of a parallel-plate device, of the field distribution over the aperture in slits of 3.5λ, 3λ, 2.21λ, 1.27λ width (λ = wavelength) are discussed, and show satisfactory agreement with the exact solution for slits of width 1.27λ and 2.21λ. The exact solution of diffraction by a slit due to a line source is also presented.

538.56

17104 AN ELECTROMAGNETIC DIFFRACTION PROBLEM INVOLVING UNIDIRECTIONALLY CONDUCTING SURFACES. R.A.Hurd.

Canad. J. Phys., Vol. 38, No. 10, 1229-44 (Oct., 1960).

The exact value of the electromagnetic field scattered by a unidirectionally conducting surface under plane wave excitation is obtained. The surface, which is an entire plane, is the junction of two unidirectionally conducting half-planes whose conductivity directions are inclined at an arbitrary angle to each other, and to the boundary line.

538.56

17105 AN APPARATUS FOR THE STUDY OF POLARIZATION BY DIFFRACTION OF CENTIMETRIC ELECTROMAGNETIC WAVES. A.Mevel and J.Mevel.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 133A-139A (Dec., 1958). In French.

A semi-automatic apparatus for measuring polarization of scattered waves in free space was constructed. A rotating analyser is used together with an oscillograph to determine the polarization ellipses. A block diagram of the apparatus and details of the various original components are given. Curves corresponding to various values of ellipticity have been computed and samples of the oscillographic patterns obtained are illustrated.

538.56 : 534.26 : 621.371

17106 BACKSCATTERING FROM A FINITE CONE. J.B.Keller.

I.R.E. Trans Antennas Propagation, Vol. AP-8, No. 2, 175-82 (March, 1960).

Backscattering is calculated for an acoustic wave incident on a hard or soft finite cone, and for an electromagnetic wave incident on a perfectly conducting finite cone. Two shapes of cone are treated, one with a flat base and the other with a rounded base. The calculation is based on the geometrical theory of diffraction. It is probably valid for wavelengths as large as the cone dimensions or smaller. Graphs of the backscattering cross section versus cone angle and versus wavelength are given for axial incidence on the flat-based cone. Suggestions for shaping an object to minimize its backscattering are also included.

538.56 : 621.371

17107 RECIPROCITY AND SCATTERING BY CERTAIN ROUGH SURFACES. W.S.Ament.

I.R.E. Trans Antennas and Propagation, Vol. AP-8, No. 2, 167-74 (March, 1960).

Reciprocity theorems are developed for the average field specularly reflected, and the average power randomly scattered, to a point by a statistically described array of objects. A reciprocal quasi-variational expression for the average power is developed for use when the self-consistent method applies to calculating currents in the individual objects, This formula is applied to calculate differential scattering cross-sections for two idealized arrays bounded by plane "rough surfaces". General conclusions, relating to reciprocity, power conservation, grazing behavior, etc., for rough surface scattering, are made and applied heuristically to show that grazing reflection and backscatter from the rough ocean should be independent of polarization.

538.56 : 621.391.812.634

17108 SCATTERING OF RADIO WAVES BY AN IONIZED GAS IN THERMAL EQUILIBRIUM. J.A.Fejer.

Canad. J. Phys., Vol. 38, No. 8, 1114-33 (Aug., 1960).

A theory is developed for the scattering of radio waves by density fluctuations which exist in an ionized gas in thermal equilibrium. Expressions for the frequency power spectrum of the scattered waves are obtained. These expressions make it possible to interpret the results of observations of this type of scattering from the ionosphere in terms of electron density and temperature. It is shown that if the characteristic scale of the scattering irregularities (this scale depends on the wavelength of the incident radio wave and the scattering angle) is much greater than the Debye length then the width of the spectrum of the scattered signal is determined by the thermal velocities (and the collision frequencies if the latter are sufficiently high) of the positive ions, rather than of the electrons. If the characteristic scale is greater than the Debye length then for low collision frequencies the spectrum is flat-topped, with two slightly raised shoulders situated symmetrically above and below the frequency of the incident wave. For high collision frequencies the spectrum has only one maximum situated at the frequency of the incident wave.

538.56 : 621.37

17109 COUPLING OF RECTANGULAR WAVEGUIDES BY MEANS OF A HOLE IN THE WIDE WALL. A.N.Akh

Zh. tekh. Fiz., Vol. 30, No. 7, 851-4 (July, 1960). In Russian.

Obtains formulae (with empirical corrections) for the coupl between two guides by means of a single circular hole for arbit wall thickness, hole diameter and its distance from the guide ax The formulae are compared with experimental results in the 3 c and the 8 mm bands, for $d/\lambda_g < 0.33$ (d = hole diameter; λ_g = wa length in the guide); they can be used in the design of directional couplers. J.K.Skwirzy

53

17110 SLOW WAVES IN A HELICAL GUIDE WITH PLASM B.M.Bulgakov, V.P.Shestopalov, L.A.Shishkin and I.P.Yakimenko.

Zh. tekh. Fiz., Vol. 30, No. 7, 840-50 (July, 1960). In Russian.

Derives and discusses the dispersion equation of a helix wou on a dielectric tube, inside which there is plasma. A steady ma field is applied along the guide axis. The slow waves can be pro gated over a wide frequency band. In the presence of the magne field the phase velocities of forward and of backward waves are different; the difference of velocities can be increased by dimin ctg φ (φ = helical angle), by reducing the clearance between the h and plasma and by bringing nearer the frequency ω and the precession frequency ω_0 of the magnetic field. When $\omega < \omega_0$, there four waves in the system (two forward and two backward). Two these (one forward and one backward) are attenuated less than i free helix. The system is also considered without the magnetic field. J.K.Skwirzy

538.56 : 53

PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA WHICH PARTIALLY FILLS A CIRCULAR WAVEGUID

See Abstr. 17005

538.56 : 621.385.

17111 THEORY OF A MODIFIED SPIRAL WITH REVERSE WINDING. S.S.Kalmȳkova and V.P.Shestopalov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 813-16 (Aug. 1, 1960). In Russian.

The dispersion equation was obtained by the variational me using the concept of spatial resonance. The current distributio established for this case and compared with the current distrib in the ordinary spiral and in a double spiral with reverse windi Comparison of dispersion curves of the modified spiral with tho a double spiral with reverse winding shows that in the region of longitudinal waves $\lambda_g > D$, where D is the period, the differen are small. In the region of the short waves $\lambda_g < D$, these differ become appreciable due to the configuration of the two spirals. energy density and the harmonic content for the first three com nents were evaluated and compared with those for an ordinary s and for a double spiral with reverse winding. Good experimenta agreement with theory is reported. Z.F.Vo

538.56 : 621.396.

17112 RESPONSE OF A LOADED ELECTRIC DIPOLE IN IMPERFECTLY CONDUCTING CYLINDER OF FIN LENGTH. C.W.Harrison, Jr and R.W.P.King.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 3, 289-93 (May-June, 19

Analytical relationships are developed which permit calcul of the power in the load impedance of an electric probe, symmetrically located within an imperfectly conducting cylinde small radius compared to the wavelength, in terms of the elect field incident upon the cylinder.

538.56 : 621.396.6

17113 IMPEDANCE CHARACTERISTICS OF A UNIFORM CURRENT LOOP HAVING A SPHERICAL CORE. S.

J. Res. Nat. Bur. Stand., Vol. 64D, No. 3, 295-9 (May-June, 196

The radiation impedance is derived by the electromotive fo method in a convenient form as the sum of the self-radiation impedance of a loop in the free space and an additional term du the reaction between the loop and the sphere which is proportio to the well-known expansion coefficient of a magnetic-type scat wave from a sphere in an incident plane wave. The first antiresonance frequency has been given in the form of a universal c

very small uniform current loop with core of an arbitrary
sition of μ_s and ϵ_s, subject to the condition that the refraction
cient $N = \sqrt{\mu_s \epsilon_s}$ is extremely large. Some numerical
ations show that high -μ core is desirable for a comparatively
frequency region, and high - ϵ core is rather desirable in an
sonance region.

538.56 : 621.391.812.622

114 ON THE MODE THEORY OF VERY-LOW-FREQUENCY PROPAGATION IN THE PRESENCE OF A TRANS-
E MAGNETIC FIELD. D.D.Crombie.
s. Nat. Bur. Stand., Vol. 64D, No. 3, 265-7 (May-June, 1960).
he effect of a purely transverse horizontal magnetic field
propagation of very-low-frequency (v.l.f.) waves is considered
shown that the magnetic field introduces nonreciprocity, and
or propagation along the magnetic equator, the rate of
uation is less for west-to-east propagation than for east-to-west
gation.

538.56

115 FOCUSING, DEFOCUSING, AND REFRACTION IN A CIRCULARLY STRATIFIED ATMOSPHERE. K.Toman.
s. Nat. Bur. Stand., Vol. 64 D, No. 3, 287-8 (May-June, 1960).
Focusing, defocusing, astronomical refraction and path length
ys as a function of the departure angle Δ of the ray at the
ce is described for cases with the source outside, inside, or on
oundary of a circular stratification. Relative to zero elevation
symmetrical and centrosymmetrical distributions are found.

538.56

116 DAMPING COEFFICIENT OF VIBRATING ELECTRONS. V.Marasigan.
mos. terrest. Phys., Vol. 19, No. 1, 65-7 (Sept., 1960).
A Druyvesteyn distribution is substituted for the assumed
wellian distribution in the derivation of the damping coefficient
brating electrons. The consequences are discussed.

538.56 : 621.371

7117 PROPAGATION CONSTANTS FOR ELECTROMAGNETIC WAVES IN WEAKLY IONIZED, DRY AIR.
.Phelps.
ppl. Phys., Vol. 31, No. 10, 1723-9 (Oct., 1960).
Formulae and graphs are given for the calculation of the pro-
ation constants of an electromagnetic wave in weakly ionized,
air at ionospheric temperatures in the presence of a magnetic
d. Experimental studies of electron collision frequencies in
ogen and oxygen are reviewed and used to obtain the magnitude
energy dependence of the electron collision frequency in air.
equations for the components of the conductivity tensor are
eloped taking into account the approximately linear dependence
he electron collision frequency on electron energy. Expressions
ived on this assumption are found to be accurate except at low
peratures, high pressures, and low frequencies. The errors
ulting from the use of an effective value for the energy indepen-
t collision frequency in the Appleton—Hartree equations are
luated. Procedures are given for the calculation of the propa-
ion constants for electromagnetic wave propagated parallel to
perpendicular to the magnetic field. These results are then
lied to the derivation of relations required to reanalyse the
ospheric collision frequency measurements reported by Kane.
use of an effective collision frequency is found to lead to errors
parable to the experimental errors in the ionospheric
ervations.

538.56

17118 TRANSIENT MODES OF HIGH-FREQUENCY RADIO WAVE PROPAGATION ACROSS THE AURORAL ZONE.
.Fulton, L.E.Petrie and W.S.P.Ward.
tmos. terrest. Phys., Vol. 16, No. 1-2, 185-6 (Oct., 1959).
Ionograms taken at oblique incidence between Winnipeg and
solute Bay often show transient extra traces; some examples are
en. The mechanism of propagation may involve scattering from
ospheric irregularities, but without further information the
hors cannot distinguish between various possible cases.

D.M.Schlapp

538.56

17119 THE EFFECT OF THE EARTH'S MAGNETIC FIELD ON M.U.F. CALCULATIONS. K.Davies.
atmos. terrest. Phys., Vol. 16, No. 1-2, 187-9 (Oct., 1959).

It is shown that calculations of maximum usable frequency which neglect the effect of the earth's magnetic field may give an m.u.f. 7.5% too low in a typical case. Suggestions are made for improving m.u.f. calculations by taking the earth's field into account.

D.M.Schlapp

538.56 : 551.5 : 621.391.812

V.L.F. ATTENUATION FOR EAST—WEST AND WEST—EAST DAYTIME PROPAGATION USING ATMOSPHERICS.
See Abstr. 16488

538.56

17120 FOCUSING OF ELECTROMAGNETIC WAVES BY E_s-CLOUDS. G.Umlauft.
J. atmos. terrest. Phys., Vol. 18, No. 2-3, 253-5 (June, 1960).

Usually partial reflection from the E_s layer reduces the amplitude of echoes from the F layer. On occasions, however, the presence of the E_s layer has a contrary effect. A qualitative mechanism for focusing that involves globules of increased ionization in the E_s layer is suggested.

D.Walsh

538.56

17121 STATISTICAL ANALYSIS OF FADING OF A SINGLE DOWN-COMING WAVE. P.Dasgupta and K.K.Vij.
J. atmos. terrest. Phys., Vol. 18, No. 4, 265-75 (Aug., 1960).

The paper deals with the statistical analysis of fading of a single wave reflected (vertically) from the F-region of the ionosphere. These fading records are usually random and their amplitude distribution has been found by other workers to be Rayleigh, Gaussian or log-normal. The present analysis shows that the amplitude distribution is Rayleigh only in the case of rapid fading, whereas for slow and quasi-periodic fading it is found to represent what can be termed as an M-type. The distribution of successive differences in the amplitudes has also been studied; for a Rayleigh amplitude distribution, this time analysis gives rise to a Type-VII distribution of Pearson (1931) as originally pointed out by Mitra (1949) while in the case of M-type amplitude distribution it becomes Gaussian. Following Mitra's analysis, the r.m.s. value of the random velocity v_0 of the ionospheric irregularities has been calculated from the time analysis. The value of v_0 has also been calculated from the autocorrelation coefficient of the amplitude R following Booker et al. (1950). The two values of v_0 thus obtained are compared and are found to agree well.

538.56 : 621.391.812.63

17122 ON THE THEORY OF REFLECTION OF LOW- AND VERY-LOW-RADIOFREQUENCY WAVES FROM THE IONOSPHERE. J.R.Johler and L.C.Walters.
J. Res. Nat. Bur. Stand., Vol. 64D, No. 3, 269-85 (May-June, 1960).

The rigorous application of the magneto-ionic theory to the calculation of reflection coefficients for a sharply bounded ionosphere model is carried out, illustrated with computations applicable to the D or E-region of the ionosphere. The quasi-longitudinal approximation is derived from this theory and the range of validity of this approximation is illustrated. The restrictions imposed by the use of a sharply bounded model ionosphere are discussed.

538.56 : 525 : 551.5

USE OF GEOSTATIONARY SATELLITES FOR THE STUDY OF IONOSPHERIC RADIO-WAVE PROPAGATION. See Abstr. 16427

Radiofrequency Spectroscopy Techniques

538.56

17123 RECORDING R.F. SPECTROMETER FOR NUCLEAR QUADRUPOLE ZEEMAN SPECTRA. C.Dean.
Rev. sci. Instrum., Vol. 31, No. 9, 934-41 (Sept., 1960).

A semi-automatic recording spectrometer system finds the loci of magnetic field orientations, relative to a single crystal sample, for which an unsplit component occurs in the Zeeman spectrum of chlorine nuclear quadrupole resonances from the sample. The system operates continuously without attention, except for approximately daily resetting, for up to several weeks to obtain the data for crystals with weak spectra. Circuit diagrams are given for the system components, and the analysis of the data is discussed.

538.56

17124 APPLICATION OF ANALOG COMPUTERS TO E.S.R. SPECTROSCOPY.

M.L.Randolph.

Rev. sci. Instrum., Vol. 31, No. 9, 949-52 (Sept., 1960).

By coupling an analogue computer to a conventional high-sensitivity electron spin resonance spectrometer, the total absorption of e.s.r. spectra, which is essentially proportional to the total number of resonances present, is obtained automatically with a typical standard error of 8% for uncorrected data or 2% for simply corrected data. Other considerations inherent in the combination of such equipment are also discussed. An experimental check of the linear dependence of first moment of the usual spectrometer output on field modulation is given.

538.56

17125 DOUBLE RESONANCE TECHNIQUE FOR THE ELIMINATION OF PROTON SPIN—SPIN SPLITTING IN HIGH RESOLUTION P.M.R. SPECTRA.

R.Kaiser.

Rev. sci. Instrum., Vol. 31, No. 9, 963-5 (Sept., 1960).

The double resonance technique aims at removing the effect of spin—spin coupling by the application of a strong r.f. field at the resonance frequency of the disturbing nucleus in addition to the weak r.f. field used for observation of the n.m.r. spectrum. A method is described whereby the weak r.f. field is obtained by a small audio-frequency modulation of the magnetic field strength. This method is applicable to chemically nonequivalent groups of hydrogen nuclei to simplify the interpretation of high resolution proton magnetic resonance spectra. Two examples are given.

538.56

17126 TRANSISTORIZED AUTODYNE DETECTOR FOR E.S.R. AND N.S.R.

F.Bruin and P.C.Van Soest.

Rev. sci. Instrum., Vol. 31, No. 8, 909 (Aug., 1960).

The transistor circuit described gives an ESR signal/noise ratio with a DPPH sample which is slightly inferior to that obta able with a vacuum-tube circuit. The many advantages of the t sistorized circuits are described.

J.M.

5

17127 SIMPLE TRANSISTOR MARGINAL OSCILLATOR F MAGNETIC RESONANCE.

B.Donnally and T.M.Sanders, Jr.

Rev. sci. Instrum., Vol. 31, No. 9, 977-8 (Sept., 1960).

A circuit for nuclear magnetic resonance measurement is described. It is self-contained, simple, nonmicrophonic, and n critical and has been used in a variety of measurements in both research and instructional laboratories. The sensitivity of the device is approximately one-half that of a Pound—Knight—Watk system.

538.56 : 621.31

17128 TRANSISTORIZED FREQUENCY STABILISATION REFLEX KLYSTRONS USED IN MAGNETIC RESONANCE.

P.Jung.

J. sci. Instrum., Vol. 37, No. 10, 372-4 (Oct., 1960).

The description of a fully transistorized frequency stabiliz for reflex klystrons is given. This is suitable for magnetic-re nance experiments and other microwave applications, where fr quency stability is essential. In a typical case (klystron type 2K25, cavity Q = 3000) the effect of ripple and drift of the powe supply is reduced by a factor of 1000.

NUCLEAR AND ATOMIC PHYSICS

539

17129 SOPHOMORE LABORATORY COURSE IN MODERN PHYSICS.

S.B.Brody.

Amer. J. Phys., Vol. 28, No. 8, 736-9 (Nov., 1960).

A new laboratory course in atomic physics using standard commercial apparatus, has been developed for students in their second year of physics. The experiments, apparatus sources, laboratory procedures and results are briefly discussed.

APPARATUS . PARTICLE DETECTORS

539.1.07

17130 BEHAVIOUR OF OPEN AIR POINT COUNTERS AT HIGH TEMPERATURES.

T.Lewowski and B.Sujak.

Acta phys. Polon., Vol. 18, No. 5, 411-18 (1959). In German.

In the temperature region 20°-500° C investigated, the operating voltage of windowless air point counters can be lowered by about 30%. When these counters were operated in the corona region as simple α-particle detectors (spark counters), it was found that at temperatures over 100° C their characteristics are independent of the water vapour content of air, they possess a long and flat plateau, and their operating potential can be as low as 2300 V at about 450° C.

I.C.Demetsopoullos

539.1.07

17131 NUCLEAR SPECTROMETRY USING PROPORTIONAL COUNTERS IN COINCIDENCE.

G.Charpak and F.Suzor.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 167A-170A (Dec., 1958). In French.

A description is given of a proportional counter spectrometer specially adapted to the study of low energy radiations (electrons or photons below 20 keV) emitted by radioactive atoms with very small probability. Two proportional counters of 18 cm diameter are in contact along a plane which contains the source holder. The source is in direct contact with the gas of one of the counters. Impulses of this counter in coincidence with impulses of the ot are analysed by a multichannel analyser. The associated electronics is described with particular emphasis on the problems non-overloading qualities of the amplifiers.

539

17132 A PROPORTIONAL COUNTER SYSTEM WITH SMA WALL EFFECT.

R.W.P.Drever, A.Moljk and S.C.Curran.

Nuclear Instrum., Vol. 1, No. 1, 41-5 (Jan., 1957).

The wall effects interfering with low energy measurements with proportional counters using gaseous sources are discusse and a new type of counter in which they are considerably reduc described. A layer of gas surrounding the sensitive volume is turned into a separate detector by a multiwire counting system which prevents escaping electrons or X-rays being registered. Applications to a new measurement of the L/K-capture ratio of and to low level counting, are described.

539

17133 ELIMINATION OF END EFFECTS IN PROPORTIO COUNTERS.

C.P.Sikkema.

Nuclear Instrum., Vol. 1, No. 3, 148-51 (May, 1957).

The method of Rossi and Staub for eliminating end effects proportional counters has been extended to much smaller wire thicknesses, thus making it suitable for most practical applicat The technique developed for glass coating platinum wire, and constructing electrodes with screened connections is describe detail.

539

17134 A PROPORTIONAL COUNTER FOR LOW LEVEL COUNTING WITH HIGH EFFICIENCY.

H. De Vries, M.Stuiver and I.Olsson.

Nuclear Instrum. and Methods, Vol. 5, No. 2, 111-14 (Aug., 195

Two small nearly identical counters have been built in the dating laboratories in Groningen and Uppsala, from essentially same material. The counting space is lined with quartz covere conducting layer; it is enclosed in a copper cylinder at ground al. The backgrounds are 1.33 and 0.9 cpm. The total es are 0.551 with efficient volumes of about 0.461.

539.1.07 : 539.12

LUMINIUM PROPORTIONAL COUNTER FOR THE UREMENT OF LOW FAST NEUTRON FLUX. See 17357

539.1.07 : 621.387.4

35 THE IONIZATION DETECTORS.

U.Facchini.

ar Electronics Conference, Paris, 1958. Vol. I. (see Abstr. of 1960) p. 83-102.

review of developments, including improvements in energy ution and applications to geology and spectrometry, and a ssion of the basic process involved. 54 references are given.

W.G.Stripp

539.1.07

136 EFFECT OF FINITE SIZE OF IONIZATION CHAMBERS ON MEASUREMENTS OF SMALL PHOTON SOURCES.

do and M.L.Randolph.

tion Research, Vol. 3, No. 1, 37-60 (July, 1960).

more rigorous surface-integral theory than that of Spiers r. 1376 of 1941) is presented to account for experimental tions of ion chamber readings from the inverse square law. lts of the new theory agree with those of Spiers for spherical bers, but differ for cylindrical chambers. Experimental data show that both theories account for deviations from the inverse e law to better than ± 3%, but do not demonstrate the superiority her.

J.E.Gore

539.1.07

7137 ON THE PULSE SHAPE IN A CYLINDRICAL IONIZATION CHAMBER.

C.Cernigoi, G.Pauli and C.Poiani.

ear Instrum., Vol. 2, No. 3, 261-9 (April, 1958).

A fast ionization chamber, 60l. in volume, filled with argon at m, is described. The pulse shapes are calculated assuming onization: (a) confined to an infinitesimal volume of the chamber; istributed along a straight line parallel to the axis of the ber; (c) distributed along a straight line passing through the of the chamber and perpendicular to it; (d) distributed along a ght line perpendicular to the axis of the chamber and not ing through it; (e) distributed throughout the volume of the ber. A comparison is made between the theoretical pulse es and the experimental ones.

539.1.07 : 539.12

PRECISION IONIZATION CHAMBER FOR HIGH ENERGY AYS. See Abstr. 17298

539.1.07 : 539.17

FLUX PERTURBATION PRODUCED BY ION CHAMBERS AND ION CHAMBERS. See Abstr. 15621

539.1.07 : 537.59

TRIGGERED SPARK COUNTER ARRAYS OF LARGE AREA JARE METERS) FOR EXPERIMENTS ON VERY HIGH ENERGY MIC RAY PARTICLES. See Abstr. 17455

539.1.07 : 621.383.27 : 621.387.464

7138 THE SCINTILLATION COUNTER.

G.A.Morton.

ear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 9 of 1960). p. 3-13.

The characteristics of various scintillator materials and of a ber of photomultipliers are compared. The loss of energy ribution due to the scintillator and photomultiplier efficiency instability, as well as the statistical time errors in both ponents, are discussed. In the scintillator, time errors arise use the emission of photons is a random process; in the photo-iplier, the time distribution is due mainly to differences in the lengths of electrons. Developments aimed at improvement of multiplier are discussed and some circuits for measurement of short time interval are described.

W.G.Stripp

539.1.07 : 621.387.464

7139 THEORY OF TIME RESOLUTION IN SCINTILLATION COUNTERS.

E.Gatti and V.Svelto.

lear Instrum. and Methods, Vol. 4, No. 4, 189-201 (May, 1959).

Four methods of handling the output pulse current of a scintillation counter, for extracting time information, have been theoretically compared. Final graphs are given for the time resolution, which can be obtained with the four methods, as a function of parameters that describe the multiplier phototube and the scintillator.

539.1.07

17140 EFFECT OF PULSE HEIGHT SELECTION ON TIME RESOLUTION IN SCINTILLATION COUNTERS.

T.Kohonen.

Ann. Acad. Sci. Fennicae A VI, No. 50, 9 pp. (1960).

Taking into account the effect of pulse-height distribution of scintillations and the subsequent amplitude selection of photomultiplier pulses a posteriori, the ultimate time resolution due to the scintillator is calculated on the basis of a new theory. The results are represented in a closed form

$$p^{N}(\alpha,n) = \frac{\alpha^{n-1}(1-\alpha)^{N-n}}{(n-1)\,!\,(N-n)\,!}\,F(N),$$

which gives the distribution of instants of time $\alpha(t)$, when a certain amount n of photoelectrons are collected at the cathode. The time-dependent parameter $\alpha(t)$ is in the case of an exponentially decaying scintillation equal to $1 - e^{-t/\tau}$, where τ is the decay time of the scintillator. The amplitude selection level corresponds to total N of photoelectrons at the cathode. The following conclusions are drawn: (a) The form of the initial pulse height distribution has no effect on the standard error of t; (b) if $n \ll N$, the results approximately agree with those calculated by Post and Schiff (Abstr. 3588 of 1951), where neither the pulse height distribution nor the amplitude selection has been taken into account; (c) however, if the size of light-pulses is kept constant, and n is N/2, the amplitude selection brings about an improvement by a factor of $1/\sqrt{2}$.

539.1.07

17141 TEMPERATURE COEFFICIENTS OF SCINTILLATING SYSTEMS.

W.P.Ball, R.Booth and M.MacGregor.

Nuclear Instrum., Vol. 1, No. 2, 71-4 (March, 1957).

Temperature coefficients of several photomultiplier tube-scintillator combinations and of photomultiplier tubes separately have been measured over the temperature range from 5°C to 40°C. The coefficients, which are negative, are functions of the temperature. The coefficient for the photomultiplier-scintillator combination is typically -0.5% deg $^{-1}$C, which means that temperature regulation is essential for systems which require accurate gain stability.

539.1.07 : 621.387.4

17142 MULTI COINCIDENCE GONIOMETER FOR ANGULAR CORRELATION MEASUREMENTS.

T.R.Gerholm, T.Lindqvist and H.de Waard.

Nuclear Instrum., Vol. 1, No. 2, 102-11 (March, 1957).

Four scintillation detectors view the same source. All six coincidence combinations between these are recorded simultaneously. A "coincidence cross delay" speeds up the measurement of angular correlations by another factor of two. It is shown that the instrument is self-monitoring and that the coincidence counting efficiency is an order of magnitude higher than in a conventional arrangement with two detectors. It is concluded that the instrument is suitable for the study of very short lived isotopes. The apparatus was checked with the Co^{60} 1.17-1.33 MeV cascade and the Bi^{207} 1.06-0.57 MeV cascade.

539.1.07

17143 REDUCTION OF DISPERSION IN SCINTILLATION DETECTORS.

J.F.Vervier and P.C.Macq.

Nuclear Instrum., Vol. 1, No. 5, 282-8 (Sept., 1957). In French.

The influence of resistance R and capacity C between the anode of the photomultiplier and the whole, on the time dispersion of pulses from a scintillation detector due to amplitude fluctuations, has been studied. Optimum conditions for minimizing the dispersion are discussed. Some experimental arrangements for reducing the capacity C, and so time dispersion, are described.

539.1.07

17144 STATISTICAL SPREAD IN PULSE SIZE OF THE SCINTILLATION SPECTROMETER.

A.Bisi and L.Zappa.

Nuclear Instrum., Vol. 3, No. 1, 17-24 (July, 1958).

The results of an experimental investigation concerning the statistical spread of the pulse sizes of the scintillation spectrometer are reported. It was found that for γ-ray energies lower than 800 keV the measured half-width η of the lines fit strictly the relation $\eta^2 = \alpha + \beta/E$ where the two constants α and β vary slightly from one spectrometer to another. At higher energies the half-widths appear to be considerably smaller than predicted from the previous relation. That is due to the fact that at the high energies the γ-rays are absorbed in the phosphor not only by photo-electric effect, but any combination of processes by which the γ-ray is completely absorbed, can happen. All the experimental results are compared with statistical predictions.

539.1.07

17145 GLASS SCINTILLATORS FOR PROMPT DETECTION OF INTERMEDIATE ENERGY NEUTRONS.

P.A.Egelstaff.

Nuclear Instrum., Vol. 1, No. 4, 197-9 (July, 1957).

Borate and phosphate glasses have been made which dissolve organic scintillators. The use of such "glass scintillators" for the detection of neutrons has been investigated and the most promising type is a heavy element containing phosphate glass.

539.1.07

17146 RESPONSE CURVES OF ALKALI HALIDE SCINTILLATORS WITH SPECIAL REFERENCE TO THE Li^6(n,α) REACTION IN LITHIUM IODIDE. T.R.Ophel.

Nuclear Instrum., Vol. 3, No. 1, 45-8 (July, 1958).

Proton and gamma-ray responses of the alkali halide scintillators, NaI, KI, CsI, LiI and Li^{6}I have been obtained and the response of a 5 MeV proton was found to be approximately equivalent to the response of a 7 MeV electron for all five scintillators. Special emphasis was given to the responses of LiI and Li^{6}I in an attempt to clarify various anomalies which have arisen in the course of neutron energy measurements with LiI by means of the Li^6(n,α) reaction. From an estimate of the triton response of LiI and Li^{6}I, which was derived from the proton and gamma-ray data inconjunction with the alpha-particle response and measurements of the pulse height of the Li^6(n,α) group, it has been shown that energy calibration of the Li^6(n,α) group with gamma rays is unsatisfactory.

539.1.07

17147 RELATIVE SCINTILLATION EFFICIENCIES OF NOBLE GAS MIXTURES. J.A.Northrop and J.C.Gursky.

Nuclear Instrum., Vol. 3, No. 4, 207-12 (Oct., 1958).

An investigation has been made of the relative amounts of scintillation light emitted from mixtures of the noble gases during the 0.5 μsec interval following the stopping of an α-particle. A bellows pump and a hot uranium furnace in a closed circulation system maintained gas purity. A diphenyl stilbene coating on the photomultiplier tube and the walls of the scintillation volume acted as a wavelength shifter for the primary ultraviolet radiation. Data on the efficiency of various proportions of binary combinations of xenon, krypton, argon, neon, and helium are presented. They show a characteristic large drop in the light for mixtures containing a small proportion of the heavier gas in a major fraction of the lighter. These results may be qualitatively interpreted in terms of noble gas molecular ion formation. The large light output of the 10%Xe—90%He mixture might be useful in constructing a neutron spectrometer of high efficiency using the He^3(n,p)H^3 reaction.

539.1.07

17148 EFFECT OF CRYSTAL THICKNESS AND GEOMETRY ON THE ALPHA-PARTICLE RESOLUTION OF CsI(Tl). P.Martinez and F.E.Senftle.

Rev. sci. Instrum., Vol. 31, No. 9, 974-7 (Sept., 1960).

The resolution of CsI:Tl for Po^{210} alpha-particles has been measured as a function of crystal thickness. The best resolution of a $\frac{1}{2}$ in. diam cylindrical crystal was obtained for a thickness of 0.38 mm, and the effect of thickness on the resolution is discussed. Based on the proposed model, a conical crystal was designed, which yielded a line width of 1.8% for Po^{210} alpha-particles with a selected photomultiplier tube.

539.1.07

17149 THIN FIBRE SCINTILLATION COUNTER FOR DETERMINING PARTICLE BEAM DISTRIBUTIONS IN ACCELERATORS. R.C.Jopson, R.E.Wright and H.Mark.

Rev. sci. Instrum., Vol. 31, No. 8, 905 (Aug., 1960).

The design and use of very flexible plastic scintillation fibres are described. Diameters of 0.5 mm or less can be obtained with sensitive elements from 1 to 10 cm long. Such fibres were used to
measure the distribution and intensity of high energy electrons
(700 keV) in an accelerator. The counter was small enough to
mize interference with the beam and its mobility allowed a rap
exploration of the beam intensity. The light pipes used transm
the light with little attenuation - it was determined that the pul
produced in the fibre by Cs^{137} internal conversion electrons we
duced by less than a factor of two in going through a 114 in. lig
pipe.
C.F.Ba

539.1.07 : 621.3

17150 THE VARIATION OF PHOSPHOR DECAY TIME WI SPECIFIC IONIZATION AND ITS APPLICATIONS.

R.B.Owen.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abs
12719 of 1960) p.27-35.

Certain organic phosphors give different shapes of scintill
pulse when excited by neutrons and γ-rays. Details are given
circuit for measurement of the decay times. No differences in
fast components of decay were apparent, but the longer-lived
components were found to be about twice as intense under neut
excitation as under γ-ray excitation. Applications in the simpl
cation and improvement of neutron counters and spectrometers
discussed.
W.G.

539.1.07 : 621.3

17151 NEW STUDIES OF THE PHYSICAL PROPERTIES ORGANIC AND MINERAL SCINTILLATORS.

L.Koch, Y.Koechlin, B.Mougin and L.Treguer.

Nuclear Electronics Conference, Paris, 1958. Vol. I, (see Abs
12719 of 1960) p. 53-6. In French.

Measurements were made to ascertain the influence of ter
ture on the photomultiplier and on the emission from the scin-
tillator, and the effect of the mode of excitation on the light int
and decay time. For a given filter, the photomultiplier temper
coefficient is constant between + 20°C and − 40°C. It is negat
from u.v. to 5500 A and positive above 5500 A. Between +4°C
+20°C, the temperature coefficient of light output is −1.2% for
ZnS:Ag scintillator and −0.5% for a plastic one, with ∝ particl
excitation. The ratio of emission for ∝ and β particles of equa
energy is 0.13 for anthracene and for plastic. Measured decay
times are given for a number of materials.
W.G.

53

17152 FATIGUE OF PHOTOMULTIPLIERS IN SCINTILL COUNTERS. M.M.Vojinović.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 94-8 (March,

The measurement of the gain stability of the scintillation cou
described. Instability due to fatigue effect of the photomultipl
observed and results for different types of photomultipliers ar
given.

53

17153 FAST ELECTRONICS IN HIGH-ENERGY PHYSICS C.Wiegand.

Nuclear Electronics Conference, Paris, 1958. Vol. I, (see Abs
12719 of 1960) p. 169-76.

After a review of the characteristics of the latest types o
scintillation and Cherenkov counters, a velocity-selecting Chere
counter is described. This consists of a cylindrical radiator,
front of which is a blackened baffle surrounded by a cylindrica
mirror which reflects the light on to three plane mirrors arra
around the axis. These reflect the light to three photomultipli
the angle of radiation for which the arrangement is adjusted
determining the particle velocity. The instrument can count
particles in the velocity range 0.6c to 0.9c. Some electronic d
used in setting up the external beams of high-energy accelera
are described.
W.G.

539.1.07 : 621

17154 A CERENKOV GAS COUNTER. M.Beneventano.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abs
12719 of 1960) p. 103-6. In French.

The counter was designed to distinguish electrons from io
in electronsynchrotron experiments, and an efficiency of 100%
aimed at. Measurements of efficiency with μ mesons showed
the desired efficiency was approached.
W.G.

539.1.07

55 SIMPLE CERENKOV DETECTOR FOR THE MEASUREMENT OF THE ENERGY OF RELATIVISTIC ED PARTICLES. M.Huq.

r Instrum., Vol. 2, No. 4, 342-7 (May, 1958).
detector using a cone-shaped perspex radiation for the rement of the energy of protons from the Birmingham Proton otron is described in this paper. The overall resolution d was ±13% most of which is contributed by the sensitivity detector to the width and angular spread of the beam. With eam conditions the resolution is expected to be ±6%.

539.1.07 : 539.12

TERNALLY REFLECTING CERENKOV COUNTER FOR ENERGY PROTONS. See Abstr. 17337

539.1.07 : 621.382.2 : 621.387.4

56 THE USE OF SEMICONDUCTORS AS DETECTORS OF NUCLEAR RADIATIONS.

al, L.Koch, Nguyen van Dong and C.Schneider.
ar Electronics Conference, Paris, 1958. Vol. I. (see Abstr. of 1960) p. 137-49. In French.
ives the results of measurements of the pass band, sensitivity /n. ratio of germanium junction photodiodes and transistors. band and sensitivity both increase with the inverse voltage, the s./n. ratio exhibits maxima. Experiments using junctions ect detectors showed that energy resolution improved with asing bias voltage. For β-and γ-ray measurements, a scin- r was interposed between the source and the crystal to prevent ase of sensitivity by high-energy particles. The method is at nt of interest only for dosemeters. Experiments were also in the detection of thermal neutrons, in which the counting ency was low, but may be improved by boron enrichment, and conversion of nuclear to electrical energy. If a load resistance nnected across the junction, and if this is irradiated, a current . With a β-ray flux of 10 mc/cm^2, outputs of 10^{-8} to 10^{-9} W obtained. W.G.Stripp

539.1.07 : 621.374.32

157 A TRANSISTORIZED RADIATION MONITOR.

D.C.Brown and B.P.Faraday.
ear Instrum., Vol. 1, No. 3, 133-7 (May, 1957).
Describes the investigation of a number of possible semicon- or devices which can be used for the detection of radioactive icles. The sensitivities of two types of transistor (a p—n—p junction and an n—p—n grown junction) and a p—n alloy junction e operated up to its "avalanche" condition were determined. possible uses of such detectors are discussed and they are n to be particularly suitable where high rates of counting, with efficiency and small detecting area (or low geometry) are ired. A completely transistorized radiation monitor has been loped using a p—n—p transistor as the detector head. This is ifically designed for α-particle detection but the detector head slight modification should be suitable for proton or neutron ction.

539.1.07

7158 ON DIFFUSION CLOUD CHAMBERS.

H.Slätis.
ear Instrum., Vol. 1, No. 4, 213-26 (July, 1957).
A short survey is given on the development of the diffusion d chamber. Langdorf's theory is briefly reproduced, and some rtant improvements in the theory made by Shutt and other stigators are mentioned. Different diffusion cloud chambers described and photographs of tracks demonstrate the use of e chambers.

539.1.07

7159 A NEW USE OF COUNTER CONTROL IN CLOUD CHAMBER OPERATION.

.Birge, R.E.Lanou, Jr, M.N.Whitehead and H.Courant.
ear Instrum. and Methods, Vol. 5, No. 3, 161-4 (Sept., 1959).
A method of cloud-chamber operation is described which in ain types of experiment can overcome the disadvantages lly inherent in the use of this instrument. The technique con- s of counter control of both the cloud-chamber and the acceler- beam. By utilizing this method, it is possible to operate at n levels considerably higher than otherwise permissible.

539.1.07 : 539.12

A γ-RAY COLLIMATOR AND EXPANSION CHAMBER FOR USE H THE 340 MeV ELECTRON SYNCHROTRON. See Abstr. 17186

539.1.07

17160 THE SELECTION OF STAINLESS STEELS FOR USE IN LIQUID HYDROGEN BUBBLE CHAMBERS. P.Amiot.

Nuclear Instrum. and Methods, Vol. 4, No. 2, 118-19 (March, 1959).

539.1.07

17161 THE USE OF TWO-COMPONENT SYSTEMS IN BUBBLE CHAMBERS. D.V.Nyagu and R.G.Salukvadze.

Rev. de Physique (Bucarest), Vol. 4, No. 4, 415-34 (1959).
In Russian.

The investigation was carried out with two and three component mixtures using CH_3I and one or two of the following: CH_4, C_2H_4, CCl_2F_2, $CClF_3$, C_3H_8, CO_2. All except the systems containing CH_3I and C_3H_8 were of low sensitivity. A table of characteristics of systems $CH_3I + C_3H_8$, $CH_3I + C_3H_8 + CO_2$ and $CH_3I + C_3H_8 + C_2H_4$ is given, from which the superiority of $CH_3I + C_3H_8$ is apparent. A detailed account of the characteristics of this system is given, followed by a theoretical discussion on the operating characteristics of two components systems. See also Abstr. 2557 of 1959 and 9912 of 1959. 24 references. J.M.Zarzycki

539.1.07

17162 THE BUBBLE DENSITY IN A BUBBLE CHAMBER UNDER DIFFERENT OPERATING CONDITIONS.

G.Horlitz and W.Paul.
Nuclear Instrum., Vol. 1, No. 6, 340-2 (Dec., 1957). In German.

The bubble density b in a bubble chamber depends on the difference between the pressure of the saturated vapour $P_\infty(T)$ and the hydrostatic pressure P, i.e. $b = F[P_\infty(T) - P]$. Therefore, b increases very rapidly with temperature, if P is kept constant. In a dirty bubble chamber, P depends on the expansion ratio and on the temperature. It was found, that for a certain expansion ratio b does not depend on temperature for an interval of several degrees.

539.1.07

17163 A NEW METHOD FOR THE RAPID MEASUREMENT OF THE SHRINKAGE FACTOR OF A NUCLEAR EMULSION.

J.Benisz and C.Borowczak.
Acta phys. Polon., Vol. 17, No. 2-3, 203-5 (1958).

Special specific gravity bottles containing the unprocessed or processed emulsions were filled with water or CCl_4 and weighed. Results for 100μ M2 emulsions agree well with those from other methods. E.J.Burge

539.1.07

17164 AUTOMATIZATION OF PHOTOMETRIC MEASUREMENTS IN NUCLEAR EMULSIONS.

C.Castagnoli, M.Ferro-Luzzi, F.Lepri and G.Pizella.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 101-6 (Aug., 1959).

A device for the automatic focusing of tracks is described, based on an electromagnetic remote control objective. Furthermore, the measurement and recording of several parameters related to the track's ionization are automatized. Time-gain, objectivity and greater precision are the main advantages of the system.

539.1.07

17165 A NEW METHOD OF GAMMA BACKGROUND ERADICATION. J.Benisz and Z.Kierskowski.

Acta phys. Polon, Vol. 18, No. 5, 527-9 (1959).

A method is described of reducing the gamma-ray background in Agfa K2 lithium-loaded nuclear plates, when exposed to neutrons. It is found that if the plates are soaked for about 2 hours in 0.1% acetic acid before development with amidol, the gamma-ray background is reduced by a factor of about 2 without any detectable change in the grain density of recoil proton tracks or triton tracks from the $Li^6(n,\alpha)T$ reaction. The effect is essentially due to a local effect of tanning. A.E.I. Research Laboratory

539.1.07

17166 A NEW NUCLEAR EMULSION "FORTE P/22".

L.Medveczky and A.Polster.
Acta phys. Hungar., Vol. 8, No. 1-2, 211-30 (1957). In German.

After a general discussion of the problems involved in producing nuclear emulsions, a new emulsion is described and its properties examined. The emulsion P/22 possesses medium sensitivity, with a 30 keV limit for electrons. E.W.Kellermann

539.1.07

17167 DIRECT READING OF THE VERTICAL COMPONENT OF PARTICLE TRACKS IN NUCLEAR EMULSION.
B.C.Maglić.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 209-10 (March, 1956).

A simple mechanical device is described which speeds up measurements by a factor 1.3-1.5 E.J.Burge

539.1.07

17168 THE LOADING OF NUCLEAR EMULSIONS WITH WATER. C.J.Batty.
Nuclear Instrum., Vol. 1, No. 3, 138-42 (May, 1957).

The rate of absorption of water by G5 emulsions has been studied at temperatures between 6° and 18°C, and the relation between swelling and water content determined. The volume of the swollen emulsion is generally less than the sum of the volumes of water and dry emulsion, and this can affect cross-section measurements. The grain density of 540 MeV proton tracks falls by about a third when 3 g of water is absorbed in 1 cm^3 of dry emulsion. An area scan for p—p elastic collisions gives, as expected, a reduced ratio of background events in the loaded emulsion.

539.1.07 : 77

17169 PARTICLE PHOTOGRAPHY [PHOTOGRAPHIE CORPUSCULAIRE]· II. Edited by P.Demers.
Montreal: Les Presses Universitaires de Montreal (1959) 459 pp.

For abstracts of the papers presented at the above Conference see Abstr. 12476-7, 12505-6, 12654, 12730-99, 12806, 12911, 13047, 13089-90, 13163, 16212-16 of 1960.

539.1.07

17170 APPARATUS FOR PROCESSING NUCLEAR EMULSIONS. E.Bujdosó and L.Medveczky.
Nuclear Instrum., Vol. 2, No. 3, 270-4 (April, 1958).

539.1.07 : 77

INTERMITTENT-ACTION CAMERA WITH ABSOLUTE TIME CALIBRATION. See Abstr. 16802

539.1.07 : 621.373.44

17171 PULSE GENERATOR AND MIXER FOR NUCLEAR RESEARCH. G.Guében.
Bull. Soc. Roy. Sci. Liege, Vol. 29, No. 5-6,119-23 (May-June, 1960). In French.

A pulse generator capable of producing pulse shapes and their combinations such as can be expected in nuclear research (photomultiplier and Geiger—Müller counter outputs as well as coincident square waves) was required for testing of complicated control and test equipment. An extention to the Tektronix (Type 545) oscillograph and pulse generator satisfying these requirements is described. A.Sczaniecki

539.1.07 : 621.374.4

17172 ELECTRONIC PULSE SCALERS I. RATIONALIZATION OF COUNTING CIRCUITS. R.L.Favre
Nuclear Instrum., Vol. 1, No. 3, 113-22 (May, 1957). In French.

Deals with new electronic circuits for pulse counting. These circuits, more practical than the binary decades, allow superior performances to be attained. A new device helps to reduce the decade, resolution time for randomly distributed pulses to that of wave-form shaping circuit. Thus the statistical loss in counting is almost eliminated.

539.1.07 : 621.374.4

17173 ELECTRONIC PULSE SCALERS. II. HIGH FREQUENCY SCALERS. R.L.Favre.
Nuclear Instrum., Vol. 1, No. 4, 201-12 (July, 1957). In French.

Deals with high frequency scaling, in which the secondary emission tube plays an important part. Aperiodic pulse generators, frequency dividers, pulse counters and electronic chronographs benefit from the proposed basic circuit. The frequency limit for these various applications reaches 30 Mc/s, while the electronic chronograph reccurence time can be lowered to 0.01 μsec.

539.1.07

17174 RATE METER CONSTRUCTION PROJECT. W.P.Davis, Jr.
Amer. J. Phys., Vol. 28, No. 6, 559-60 (Sept., 1960).

The circuits for a counting ratemeter and valve voltmeter are given. These circuits have proved suitable for construction by students and have been used as part of a project to equip a nuc
physics laboratory for second-year students cheaply and instru
tively. C.F.Ba

539.1.07 : 621.3

17175 AUTOMATIC RANGE-CHANGING OF A LINEAR RATEMETER. S.Lovett.
J. sci. Instrum., Vol. 37, No. 10, 376-8 (Oct., 1960).

A circuit is described which automatically changes the ra
of a linear ratemeter as the count rate from a flow Geiger cou
increases or decreases. The counter voltage is switched off w
the count rate exceeds the maximum that the counter is design
to accept and is switched on at intervals to sample the count r
and remains on when the rate has diminished to an acceptable

53

17176 METHOD FOR ELIMINATING THE EFFECTS OF AMPLITUDE DRIFTS IN MEASUREMENTS OF RA
OF COUNTING RATES.
G.Goldring, M.Birk, Z.Kamil and D.Mydansky.
Nuclear Instrum., Vol. 3, No. 5, 307-8 (Nov., 1958).

In measurements of ratios of counting rates, the effects of
amplitude drift can be eliminated by the use of one amplifier a
one pulse height analyser common to all radiation detectors.
mixing and relaying system incorporating this method is descr

539

17177 A SIMPLE TEN CHANNEL AMPLITUDE ANALYS
V.N.Kostić.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 105-11 (Marc
1956).

A ten channel analyser is described which uses 2.5 amplif
tubes per channel and one double diode. The window amplifier
sends pulses to the analyser has three amplifications: 10,5 and
which corresponds to the channel widths of 0.7, 1.4 and 2 V, re
tively. The window amplifier accepts the pulses having a rise
of 0.5 to 100 μsec, while the linearity is better than ±2.3%. T
resolving time of the analyser is 3 μsec.

539.1.07 : 621.

17178 A VERY FAST PULSE-HEIGHT ANALYSER WITH INDEPENDENT UPTAKE, SORTING AND STORAG
INFORMATION. R.V.Gåsström.
Nuclear Instrum., Vol. 1, No. 2, 75-9 (March, 1957).

A kicksorter is proposed with an uptake resolution of the
of 10^{-8}s and a mean counting rate without loss of 10^5 p.p.s. Th
principle is suited for both continuous as well as intermittent
ing and is based on a storage-tube display of the uptake which
scanned for sorting. The read-off information is temporarily
per channel before it is injected into a large capacity accumula
memory.

539.1.07 : 621.3

17179 COINCIDENCE ARRANGEMENT WITH HIGH TIME RESOLUTION USED TOGETHER WITH A 100-CHA
PULSE-HEIGHT ANALYZER. B.Johansson.
Nuclear Instrum., Vol. 1, No. 5, 274-9 (Sept., 1957).

A time correcting circuit is described which compensates
timespread due to different pulse heights. A resolving time of
$2\tau_0 = 9$ mμs is obtained with NaI(Tl) crystals for gamma energ
above 50 keV.

539.1.07 : 621.

17180 LINEARIZING THE BOTTOM CHANNELS OF THE 256-CHANNEL PULSE HEIGHT ANALYSER.
R.M.Rodrigues, H.I.West, Jr and J.J.Ronchetto, Jr.
Rev. sci. Instrum., Vol. 31, No. 7, 790-1 (July, 1960).

The modifications made to a 256 channel analyser to impr
the linearity of the bottom channels are described. The disadv
of the circuit used is that it inevitably increases the analyser
time (~9 μsec) but this is offset by the ability to use the botto
channels. C.F.B

539.1.07 : 621.

17181 CHARGE-STORAGE PULSE-HEIGHT ANALYZERS FOR USE WITH PULSED ACCLERATORS.
L.Costrell and R.E.Brueckmann.
Nuclear Instrum., Vol. 3, No. 6, 350-8 (Dec., 1958).

Storage type pulse-height analysers for use with low duty
pulsed accelerators are discussed and an analyser is describe

ıodates up to nine pulses in a single burst with a resolution of
icroseconds. The pulses to be analysed are temporarily
l as lines of charge on the face of a cathode-ray tube and are
ed by means of an electron beam that detects the charge dis-
uity at the peak of the pulse. The pulse-height information is
ermanently stored in a magnetic core memory.

539.1.07 : 77

182 PHOTOGRAPHIC RECORDING METHODS IN NUCLEAR PULSE SPECTROMETRY. D.Maeder.

ar Instrum., Vol. 2, No. 4, 299-331 (May, 1958).
pplications of photographic techniques in measuring pulse
tude (PA) distributions fall into 3 general groups: (1)
ding of individual events as they arrive from the nuclear
tion detector, with subsequent analysis based on visual or
electric inspection of the record; (2) time exposures of a large
s of events, the distribution analysis being provided by the
ure-density correspondence in the photographic process; (3)
or permanent storage of results from counting equipment, after
lse sorting has been performed electronically. The first and
groups are reviewed, and some improvements of existing
iques suggested. For the second group a thorough presentation
sign problems and evaluation procedures is attempted. Gray
techniques lead to a straightforward quantitative interpretation
tographed PA spectra. The simplest version of a fast GW
rometer consists of a commercial oscilloscope and a plug-in
or which provides double rectangular pulse shaping, various
corrections, overload protection, and generates an exponential
oth voltage derived from the linear oscilloscope sweep.
lute intensity evaluation from GW pictures is made possible if
pectrometer is equipped with a few electronic counting channels
n automatic channel limit marker to establish the correspond-
between the photographic curve and the channel counts. In
idence measurements both individual dot recording and density
rding of two-dimensional distributions are found useful. Again,
ining the photographic technique with a relatively small number
unting circuits permits the determination of absolute intensities.

539.1.07

7183 THE OUTPUT DISTORSION OF A DIFFERENTIAL INTERVAL ANALYZER OF UNIVERSAL DESIGN.

pinar.
ear Instrum., Vol. 1, No. 4, 200 (July, 1957).

539.1.07 : 621.317.39

7184 ELECTRONIC TIME ANALYZER APPLIED TO THE MEASUREMENT OF THE HALF-LIVES OF META-
BLE NUCLEAR STATES. P.A.Tove.

ear Instrum., Vol. 1, No. 2, 95-100 (March, 1957).
An electronic 20 channel time analyser has been applied to the
surement of the half-lives of metastable nuclear states in the
μsec region. The electronic circuits are described and meas-
ents principles discussed, with special regard to the possibility
easuring longer-lived states.

539.1.07 : 621.374.32

7185 A FAST COINCIDENCE CIRCUIT.

D.H.White and G.W.Hutchinson.

ear Instrum., Vol. 1, No. 6, 331-4 (Dec., 1957).
A coincidence circuit is described with an improved rejection
to non-coincident pulses. In the coincident condition, informa-
is gathered during a large part of the time of overlap of the
ied signals, not merely from the coincidence of the leading
s. The resolving time is comparable with that obtained using
entional circuits.

539.1.07 : 621.374.32

7186 MULTIPLE FAST COINCIDENCE UNIT.

K.Skarsvåg.

ear Instrum., Vol. 3, No. 6, 336-40 (Dec., 1958).
A fast diode coincidence unit which can be driven by photo-
tiplier pulses is described. The coincidence circuit can be
ged from a double to a triple or quadruple by a switch. A
, τ, of about 3 mμsec with 100% efficiency can be achieved.
dead time following non-coincident and coincident input pulses
about 16 and 70 mμsec respectively.

539.1.07

7187 PULSE SHAPER FOR FAST COINCIDENCE STAGES.

W.Gruhle.

ear Instrum. and Methods, Vol. 4, No. 2, 112-14 (March, 1959).
erman.
Triggered pulse generators feeding coincidence stages introduce a time dispersion due to the amplitude dependence of the trigger time. A new method combines the steep zero crossover of the double differentiated pulse spectrum with the backlash characteristic of a Schmitt trigger. With this method it is possible to set the flop-back level of the trigger circuit on the zero crossing of the signals, which is independent of amplitude. The highest possible coincidence resolution with slower scintillators may thus be reached.

539.1.07

17188 AN ELECTRONIC COINCIDENCE UNIT OF HIGH RESOLUTION. J.Christiansen.

Nuclear Instrum. and Methods, Vol. 5, No. 2, 115-19 (Aug, 1959). In German.

An electronic coincidence unit is described, which has a time resolution of 7×10^{-12} sec with artificial pulses. The statistical error of the apparatus is calculated and is shown to agree with the experimental data. Calibration was performed with a variable delay line and the linearity of the relation between pulse-height and time delay was proved within a range of 2×10^{-9} sec.

539.1.07 : 621.374.32

17189 A TRANSISTOR CIRCUIT FOR FAST COINCIDENCE MEASUREMENTS. G.B.B.Chaplin and C.J.N.Candy.

Nuclear Instrum. and Methods, Vol. 5, No. 4, 242-6 (Oct., 1959).

A coincidence circuit is described which has a short resolving time ($< 5\mu$sec), and a high rejection of non-coincident pulses; coincident one-volt pulses trigger the circuit while single 40 V pulses do not. Use is made of germanium diodes and transistors, and pulse shaping is accomplished by means of small inductances. The resulting circuit is sensitive, compact, and consumes little power.

539.1.07 : 529 : 621.374.32

17190 HIGH SPEED COUNTER CHRONOMETER.

A.M.Hillas and R.M.Tennent.

Nuclear Instrum., Vol. 13, No. 6, 344-9 (Dec., 1958).

A counter chronometer is described which measures time intervals up to 12.75 microseconds by counting the oscillations of a 20 Mc/s free-running oscillator with a scaler. Provision is made for resetting the scalar by a fast pulse if the measurement is not to be recorded. The scalar is based on conventional pentodes and germanium diodes, the high counting speed being attained by limiting voltage changes.

539.1.07 : 621.374.32

17191 A NEW METHOD FOR TIMING SCINTILLATION PULSES. F.T.Arrechi, E.Gatti and E.Zaglio.

Nuovo Cimento, Vol. 16, No. 1, 198-201 (April 1, 1960).

Describes a method of timing scintillation counter pulses by feeding the current pulse from a photomultiplier to a ringing circuit, the output of which is used to drive the vertical deflection plates of a c.r.o. with internal trigger. Standard light pulses are converted by a photomultiplier to standard current pulses, the time position being measured by a Moody discriminator. R.H.Thomas

539.1.07 : 621.374.32

17192 HIGH SPEED TRANSISTORIZED SCALE-OF-TWO.

E.Baldinger, P.Santschi and P.Wehrli.

Nuclear Instrum. and Methods, Vol. 4, No. 2, 117 (March, 1959).

539.1.07 : 621.374.32

17193 A FAST SCALING STAGE.

F.A.Muller.

Nuclear Instrum. and Methods, Vol. 4, No. 2, 115-16 (March, 1959).

A description is given of a new type of scaling stage. The tested circuit, with stray capacitances kept at a minimum, operated on incoming pulses up to 100 Mc/s.

539.1.07

17194 INCREASED SENSITIVITY OF TRIGGER CIRCUITS.

M.M.Vojinović.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 8, 123-31 (March, 1958).

A way of increasing the sensitivity of trigger circuits is described. A sensitive cathode-coupled monostable multivibrator is analysed. Experimental results showing sensitivity of a few mV and threshold stability are given. The possibility of application to pulse-height analysis is discussed.

539.1.07 : 621.374.3

17195 A NANOSECOND VERNIER ANALYZER.
C.Cottini, E.Gatti and F.Vaghi.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p. 177-83.

Pulses from two photomultipliers excite two resonant circuits (20 Mc/s and 20.2 Mc/s). The wave trains are mixed and the l.f. modulation product is passed to a phase detector and a time-to-amplitude converter. The ramp waveform used for the conversion is started by the arrival of a pair of quasi-coincident photomultiplier pulses and stopped by the first zero crossing of the modulation product. Some coincidence curves taken with the instrument are given. W.G.Stripp

539.1.07 : 621.373.44

17196 A FAST TRIGGER CIRCUIT.
F.J.M.Farley.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p. 185-7.

See also Abstr. 5901 B of 1958: Rev. sci. Instrum., Vol. 29, No. 7, 595-6 (July, 1958). The circuit uses positive feedback via a pentode used as cathode load. A version using double triodes and another with time resetting (pulse termination) by a delay line are given. W.G.Stripp

539.1.07 : 621.373.44

17197 A NEW METHOD OF PULSE TIMING APPLIED TO FAST COINCIDENCE WORK. W.Gruhle.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p. 189-93.

To avoid delay dispersion due to the dependence of triggering time on pulse amplitude, use is made of the fact that a Schmitt trigger circuit can be made to flop back at zero level. By double differentiation, the trailing edges of input pulses can made to pass through zero at a common point, thus providing the necessary constant-delay triggering. The trailing edge of the Schmitt circuit output pulse is differentiated to trigger a coincidence pulse generator. W.G.Stripp

539.1.07 : 621.374.3

17198 A NOVEL FAST COINCIDENCE CIRCUIT OF THE DICKE TYPE. W.F.Hornyak and H.Yoshiki.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p. 195-200.

See also Abstr. 1183 B of 1948: Rev. sci. Instrum., Vol. 18, 907-14 (Dec., 1947). Pulses from two inputs are conveyed to a junction A by delay cables of lengths l_1 and l_2. From A two further cables of lengths l_3 and l_4 connect to a second junction B. If $l_2 - l_1 = l_4 - l_3 = l$, the Fourier spectrum of a single pulse from one input arriving at B will have amplitude zeros at frequencies $c(2n - 1)2\Delta l$. Thus a narrow band receiver connected to B will have no output. It is shown that, for coincident pulses at the inputs, not necessarily of the same amplitude or shape, there will be a component at B with a finite amplitude. The time $\Delta l/c$ should be long compared with input durations. The preservation of a coincidence component depends on a suitable non-linear device between the junction B and the receiver. In the new development this is an overdriven distributed line amplifier. W.G.Stripp

539.1.07 : 621.374.3 : 621.317.755

17199 THE PULSE SAMPLING OSCILLOSCOPE.
P.R.Orman.

Nuclear Electronics Conference, Paris, 1958. Vol. I.(see Abstr. 12719 of 1960), 209-16.

The waveform to be displayed is sampled by pulses of 10^{-9} sec width. At each sampling, the mixer produces a 50 μsec pulse having an amplitude proportional to that of the test waveform over the sampling period. These pulses are applied to the Y plates of the c.r.t. Brightness modulation is applied so that only the tops of the pulses are visible, tracing out the shape of the test pulse on a magnified time scale. The bandwidth obtained is 300 Mc/s. W.G.Stripp

539.1.07 : 621.374.4

17200 TWO PULSE FREQUENCY DIVIDERS WITH HIGH RESOLVING POWER. U.Pellegrini and B.Rispoli.

Nuclear Electronics Conference, Paris, 1958. Vol. I (see Abstr. 12719 of 1960), p. 217-24. In French.

The first circuit divides by 16 and uses four binary counters. These have cathode-follower cross-couplings to give fast rise times, and the divider has a resolution of 34×10^{-9} sec. It will divide from sinusoidal signals up to 30 Mc/s. The other circuit divides by using a ring counter of EFP 60 secondary emission valves to d by 5 and a normal binary stage. The resolution is similar to t the first circuit. W.G.

539.1.07 : 621.3

17201 A FAST STORAGE SYSTEM FOR MULTICHANNEL PULSE HEIGHT ANALYSIS. G.F.Pieper.

Nuclear Electronics Conference, Paris, 1958. Vol. I (see Abst 12719 of 1960), p. 225-31.

The pulses to be analysed are written into a c.r.t. store as vertical deflections. The screen is then scanned by a televisio type raster starting from the bottom, and pulse heights determi by the charge discontinuities at the peaks. W.G.S

539.1.07 : 621.

17202 A COINCIDENCE CIRCUIT WITH A SHORT RESOLUTION TIME AND A HIGH COUNTING RAT
J.C.Brisson, G.Valladas and R.Van Zurk.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abst 12719 of 1960), p. 233-41. In French.

Particles are detected by n scintillators placed on their tra tories. The photomultiplier pulses are standardized to V volts added in a distributed amplifier. The sum pulse is applied to a amplitude discriminator with a threshold between nV and (n-1)V The resolution time is about 4×10^{-9} sec and counting rate abo 3×10^4 coincidences per second. W.G.S

NUCLEAR FIELD THEORY

5

17203 ACTION PRINCIPLE AND LAGRANGIAN WITH HIGHER ORDER DERIVATIVES. S.P.Misra.

Indian J. Phys., Vol. 133, No. 11, 461-8 (Nov., 1959).

Certain commutation relations of field quantities (field oper tors and their derivatives) have been obtained for space-like sep ration of the points when the Lagrangian density contains derivatives of field operators of order higher than first, by using Schw ger's operator principle of Stationary Action. The commutators thus obtained are quite complicated, and the consistency of this procedure can only be discussed in individual cases.

539

17204 DIPOLE GHOST CONTRIBUTIONS TO PROPAGATO
K.L.Nagy.

Nuovo Cimento, Vol. 15, No. 6, 993-5 (March 16, 1960).

Using the method of Gupta and the technique of Källen and Lehmann, it is shown that the relativistic generalization of a Lee model dipole ghost state results in terms similar to those in Heis berg's theory, but not identical with them. W.A.Hep

539

17205 TRIPOLE GHOSTS IN FIELD THEORY.
K.L.Nagy.

Nuovo Cimento, Vol. 17, No. 3, 384-94 (Aug. 1, 1960).

An appropriate modification of the Lee model is discussed. For a definite set of parameters beside the dipole ghost state als tripole ghost is to be found. Using the Källén—Lehmann method contributions of tripole ghost states, supposed to exist in a relati tic quantum field theory, are calculated.

539

17206 ON THE CAUSALITY OF NONLOCAL FIELD THEOR
V.D.Sutula.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 1, 77-80 (July 1, 1960). In Russian.

It is shown that the demands of relativistic invariance, macr causality, and unitarity can be satisfied up to second order in pe turbation theory by a nonlocal theory with a kernel restricted to certain class. It is also shown that the Bloch type of theory (Abs 2197 of 1953) satisfies causality, although it is not unitary. It is likely that a series of terms can be added to a Lagrangian to res unitarity without destroying the causality. D.J.Thou

539.11

207 ALGEBRAIC CHARACTERIZATION OF THE T.C.P. OPERATION. A.Grossmann.

th. Phys. (New York), Vol. 1, No. 5, 424-8 (Sept.-Oct., 1960).
f an "operation" $\mathfrak{M}$ is real and preserves Lorentz covariant ions, then $\mathfrak{M}$ is either a proper Lorentz operation or the dict of a proper Lorentz operation and the T.C.P. operation.

539.11

208 CHIRALITY INVARIANCE AND THE LORENTZ GROUP. Y.Ahmavaara.

Acad. Sci. Fennicae A VI, No. 48, 23 pp. (1960).
t is shown that the γ_5-transformations or, more in general, the lity transformations result from a mathematically unique exon of the homogeneous Lorentz group, defined in the Lie algebra a sense, in the very group space of the proper Lorentz group.

539.11

209 ARE THE LAWS OF NATURE SYMMETRICAL? O.R.Frisch.

re (London), Vol. 187, 638-41 (Aug. 20, 1960).
A brief discussion is given, in elementary terms, of parity riance in classical physics, of its breakdown in weak interons and of its replacement by invariance under the product of charge conjugation and parity operations. E.J.Squires

539.11

7210 MINIMAL ERROR IN THE EXPERIMENTAL OBSERVATION OF ASYMMETRY. N.P.Klepikov.

eksper. teor. Fiz., Vol. 37, No. 4(10), 1139-42 (Oct., 1959). ussian. English translation in: Soviet Physics—JETP (New k), Vol. 37(10), No. 4, 810-12 (April, 1960).
Estimates the probability of the error in conclusions drawn n asymmetry experiments. W.A.Hepner

539.11

7211 ON THE SUBSTITUTION LAW IN QUANTUM FIELD THEORY. O.Judge, H.Shimodaira and Y.Takahashi.

vo Cimento, Vol. 16, No. 6, 1139-41 (June 16, 1960).
Simple conditions on the interaction Hamiltonian for the validity is law are derived without using perturbation theory. A axed" substitution law, sufficient to prove crossing symmetry, lso considered. E.J.Squires

539.11

17212 AN INTERPRETATION OF QUANTUM MECHANICS. I. A NEW HYPOTHESIS. QUALITATIVE EFFECTS.

.Datzeff.
Phys. Radium, Vol. 20, No. 12, 949-58 (Dec., 1959). In French.
A causal interpretation of quantum mechanics is sought, iving from the hypothesis that the field U has a material support ovac) with a discrete structure of AS particles. The latter can up into stable formations $\Phi_k(k = 1, 2, ...)$. Interacting with Φ_k a ro-particle μ (electron etc.) is in a static condition A_k, with rgy E_k. Because of the fluctuations of Φ_k and AS the movement he particle μ should not be described by means of classical chanics but statistically. It is shown that in a number of cases obtains for the probability of the presence of μ, qualitatively the ne results as given by quantum mechanics. To find an exact ntitative description of the statistical distribution of the positions one should determine, in all cases, the probability of the sence w(x,y,z) of μ.

539.11

17213 WIGHTMAN'S FUNCTIONS AND RETARDED COMMUTATORS. II. O.Steinmann.

v. phys. Acta, Vol. 33, No. 5, 347-62 (1960). In German.
For Pt I, see Abstr. 14515 of 1960. The consequences of the ic postulates of quantum field theory (Lorentz-invariance, ality, stability of the vacuum) for the retarded products are intigated by considering their connection with Wightman's funcs. Necessary and sufficient conditions for the existence of a htman function corresponding to a prescribed r-function are en. The Fourier transform $\tilde{r}(p_1,...,p_n)$ of r is a boundary value function $\tilde{r}(k_1,...,k_n)$ regular in a domain $\bar{R}_n$. $\bar{R}_n$ is constructed a recursive procedure. Other boundary values $\tilde{g}\mu(p_1,...,p_n)$ of function are considered. They have to fulfill a set of linear ntities of four and twelve terms respectively.

539.11

17214 APPLICATION OF SCHWINGER'S ACTION PRINCIPLE TO QUANTISE A FOURTH ORDER MESON FIELD.

S.P.Misra.
Indian J. Phys., Vol. 33, No. 12, 520-30 (Dec., 1959).
Schwinger's Action Principle was applied to the case of a fourth order meson equation proposed by Bhabha and Thirring. The result obtained is not new, but the method illustrates with the simplest model the difficulties of applying the Action Principle when the Lagrangian contains even the second order derivatives of the field operator, and gives a concrete and complete example of the generalisation of the Action Principle when the Lagrangian contains higher order derivatives as given by the author previously.

539.11 : 539.18

VACUUM POLARIZATION EFFECTS ON ENERGY LEVELS IN μ-MESONIC ATOMS. See Abstr. 17672

539.11

17215 QUANTUM ELECTRODYNAMICS IN THE INFINITE ENERGY LIMIT. K.Johnson.

Ann. Phys. (New York), Vol. 10, No. 4, 536-52 (Aug., 1960).
The spectral form of the single particle Green's functions of charged fields are derived for spin zero and spin one-half fields. The restrictions imposed on the spectral weight functions by the commutation relations and the "kinematic" coupling of the charged field to the electromagnetic field are studied. It is shown that they require extremely slow convergence of the infinite integrals over the weight functions. In fact, the commonly made assumptions of uniform convergence of all such integrals with respect to any parameter of interest would lead to a contradiction of the consistency of the theory. However, it is pointed out that "reasonable" solutions of the theory could exist with the requisite convergence properties.

539.11

17216 SINGULARITIES AND DISCONTINUITIES OF FEYNMAN AMPLITUDES. R.E.Cutkosky.

J. math. Phys. (New York), Vol. 1, No. 5, 429-33 (Sept.-Oct., 1960).
The Landau singularities of the amplitude calculated from an arbitrary Feynman graph are considered. It is shown that the discontinuity across a branch cut starting from any Landau singularity is obtained by replacing Feynman propagators by delta functions for those lines which appear in the Landau diagram. The general formula is a simple generalization of the unitarity condition. The discontinuity is then considered as an analytic function of the momenta and masses; it is shown that its singularities are a subclass of the singularities of the original amplitude which corresponds to Landau diagrams with additional lines. The general results are illustrated by application to some single loop graphs. In particular, the general formula gives an immediate calculation of the Mandelstam spectral function for fourth order scattering. Singularities not of the Landau type are discussed and illustrated by the third-order vertex part.

539.11

17217 FINITE VALUE OF THE WAVE FUNCTION RENORMALIZATION CONSTANT IN QUANTUM ELECTRODYNAMICS. I.Bialynicki-Birula.

Nuovo Cimento, Vol. 17, No. 1, 122-3 (July 1, 1960).
Shows that there exists a class of gauges which give a finite value of the renormalization constant, as far as ultraviolet divergencies are concerned. The class is defined by using an inductive argument to investigate the coefficients f_i in the power series in the renormalized charge occuring in the expression for the modified Landau gauge. It is shown that the f_i can be chosen in such a way that the Z-constant is finite in every order of perturbation theory. J.W.Gardner

539.11

17218 HIGH ENERGY THEOREM IN QUANTUM ELECTRODYNAMICS. L.E.Evans.

Nuclear Phys., Vol. 17, No. 1, 163-8 (June (2), 1960).
A theorem of Lehmann, Symanzik and Zimmermann (Abstr. 9411 of 1955) on the high-energy behaviour of the meson—nucleon vertex is extended to quantum electrodynamics. It is shown that the vertex function in quantum electrodynamics vanishes in the limit of infinite momentum transfer. This theorem does not necessarily imply the vanishing of the conventional electromagnetic form factors in this limit.

539.11

17219 THE RENORMALIZATION CONSTANTS IN QUANTUM ELECTRODYNAMICS.

B.Zumino.

Nuovo Cimento, Vol. 17, No. 4, 547-57 (Aug. 16, 1960).

The asymptotic behaviour at high energies of the vertex function in quantum electrodynamics is discussed with particular consideration of the gauge invariance of the theory.

539.11

17220 LORENTZ COVARIANCE OF QUANTUM ELECTRODYNAMICS WITH THE INDEFINITE METRIC.

S.N.Gupta.

Progr. theor. Phys., Vol. 21, No. 4, 581-4 (April, 1959).

It is shown that the norm of any state vector in quantum electrodynamics with the indefinite metric is Lorentz invariant. The treatment involves the use of certain Lorentz-covariant quantities called expansors.

539.11

17221 QUANTUM ELECTRODYNAMICS AND ASYMPTOTIC CONDITIONS.

H.Rollnik, B.Stech and E.Nunnemann.

Z. Phys., Vol. 159, No. 4, 482-94 (1960). In German.

The asymptotic conditions for the field operators are used in order to employ only renormalized quantities in quantum electrodynamics and to avoid the usual procedure of adiabatic switching off of the interaction. The treatment is based mainly in invariance properties and therefore gives a somewhat simpler formulation of the renormalization procedure.

539.11

17222 SOME REMARKS ON FIELDS WITH NEGATIVE PROPAGATORS IN QUANTUM FIELD THEORY.

H.Shimodaira.

Nuclear Phys., Vol. 17, No. 3, 486-98 (July (1), 1960).

The question of introducing a field ϕ which belongs to Hilbert space II is investigated within the framework of quantum field theory. For this purpose a special model of the interaction Lagrangian, i.e. $\Psi^*\Psi(\Box - \mu^2)\phi$ (where Ψ^*, Ψ are ordinary field operators and μ is the mass of the ϕ field) is proposed, and it is found that this leads to a self-consistent theory. An extension that would be effective in eliminating divergences from the theory is also studied and it is shown that such an extension necessarily leads to the violation of the causality of the S-matrix. Since the only restriction is that ϕ be contained linearly in the interaction Lagrangian, this model serves to clarify the relation between the indefinite metric and the non-local interaction.

539.11

17223 AN ATTEMPT TO RESOLVE THE PARADOX OF LANDAU.

M.Zăgànescu.

Nuovo Cimento, Vol. 15, No. 3, 481-3 (Feb. 1, 1960). In French.

As shown by Landau the renormalized charge of an electron e is given by

$$e^2 = \frac{e_1^2}{1 + (\nu e_1^2/3\pi)\ln(\Lambda^2/m^2)}.$$

Taking $\Lambda \to \infty$, this gives a zero renormalized coupling constant, even for e_1 infinitely large. It is suggested this paradox is due to the incompleteness of the model examined by Landau, and that if the other possible interactions besides that of the electron and photon are included the problem is resolved. An example is given to illustrate this based on the hypothesis that the nature of the interaction is determined by the form of the domain of discontinuity of the group which leaves the function $\Lambda^2(y)$ invariant ($y = 1 - e^2/e_1^2$).

H.Morrison

539.11

17224 STRUCTURE OF NON-RELATIVISTIC ANTI-TERMS.

B.M.Stepanov.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 3, 547-9 (July 21, 1960). In Russian.

Presents a method of construction of anti-terms for a particular case of interaction of spinor field with a real pseudo-scalar meson field. This is a continuation of previous paper (Abstr. 101 of 1957) where the regularization of appropriate Green's function was described.

J.K.Skwirzynski

17225 DISCRIMINATION BETWEEN STRONG AND WEAK INTERACTIONS.

Y.Murai.

Nuclear Phys., Vol. 17, No. 4, 529-47 (July (2), 1960).

A discrimination between strong and weak interactions is on the basis of a five-dimensional theory in which fermions ar represented by eight-component spinors. The operators repre hyperonic charge and chirality are formed and it is shown how strangeness, as derived from them, can give a measure of the strength of the interaction. The type of coupling is determined though this depends on the assignment of new characteristics t particles.

17226 BARYON MASS-DIFFERENCES AND SYMMETRIE OF STRONG INTERACTIONS.

N.Dallaporta and L.K.Pandit.

Nuovo Cimento, Vol. 16, No. 1, 135-67 (April 1, 1960).

Previously (Abstr. 1244, 5605 of 1960) it has been shown, the Gell-Mann isobaric-doublet model of the baryons, that it i possible to construct an interaction scheme which possesses m of the usual symmetries, reproduces the N—Ξ mass differenc does not forbid any of the observed strong reactions. In the pr paper it is shown, using only the usual fermion—fermion—boso fundamental interaction, how the $\Sigma - \Lambda$ mass difference can be obtained, within the above framework, by requiring the K-inter to possess certain rotational properties in a 4-dimensional, Euclidean "hypercharge" space, a 3-dimensional subspace of w coincides with the usual isobaric spin space. A Lagrangian of t Espagnat—Prentki type with four independent constants is heuristically derived. This leads to the $\Sigma - \Lambda$ mass splitting an gives rise to constants of the motion which coincide with the is and strangeness assignments of the Gell-Mann scheme. A furt consequence of the proposed Lagrangian is that P-invariance fo automatically from CP-invariance.

J.S.Do

5

17227 SELECTION RULES IN STRONG INTERACTIONS.

S.Sasaki.

Nuclear Phys., Vol. 17, No. 3, 516-28 (July (1), 1960).

The invariances under P- and T-transformations in the electromagnetic and the mesonic interactions are discussed usi the generalized Dirac equation obtained by assuming invariance under the proper Lorentz transformation. It is shown that the existence of P- and T-invariance in the above interactions is ba on the fact that the theories must be invariant under the extende gauge-like transformations. The strong mesonic interactions a found to be derivative. The "principle of the minimal electromagnetic interaction" and the assumption of the "global symmet for the strong mesonic interactions are naturally obtained from standpoint.

539

17228 NONLOCAL INTERACTIONS AND DISPERSION RELATIONS.

Y.Miyatake.

Progr. theor. Phys., Vol. 21, No. 4, 562-8 (April, 1959).

When microscopic causality is not satisfied one cannot give usual physical meaning to the dispersion relations proposed by Oehme (Abstr. 925 of 1956). The problems of ghost seem to be closely connected with the propagation characters in the cases o nonlocal interactions.

53

17229 DOUBLET THEORY OF THE BARYON AND THE WEAK INTERACTION

F.Schlögl.

Z. Phys., Vol. 160, No. 3, 347-54 (1960). In German.

The baryon-doublet theory provides a simple scheme for the weak-interaction current of baryons and mesons. In this scheme a (K,K)-part of the currents is excluded. Such a part is not nece ary to explain the absence of renormalization effects on the vect coupling constant in β-decay.

53

17230 COUPLING CONSTANTS AND THE MASS LEVELS O BARYONS.

B.Bransden and G.Moorhouse.

Progr. theor. Phys., Vol. 21, No. 5, 760-2 (May, 1959).

Reports calculations of the baryon mass shifts for various assumed π and K couplings, using the Tamm—Dancoff method in the one-meson approximation.

R.J.N.Phil

539.11

31 AN ATTEMPT AT UNIVERSAL FOUR-FERMION INTERACTION. J.C.Pati and S.Oneda.

Cimento, Vol. 16, No. 2, 365-7 (April 16, 1960).

fficulties in finding a particular kind of "universal" weak tion scheme, to explain hyperon decay and other data, are sed. R.J.N.Phillips

539.11 : 539.16

32 A POSSIBLE MODEL FOR THE FOUR-FERMION COUPLING. E.van der Spuy.

r Phys., Vol. 18, No. 1, 153-60 (Aug. (1), 1960).

arting from a possible modification of the photon-propagator trodynamics, below a fundamental length, a generalization cohesive vector meson field thus introduced gives a possible for the four-fermion coupling effective in, for example, y. The model is based on a charged intermediate vector field of the same coupling constant as for electrodynamics. ndamental implications of a cohesive field demand a partition ert space as proposed by Heisenberg. Some implications of del relative to the universality of the coupling and the mass cohesive meson are briefly indicated.

539.11

33 STRONG FERMI-TYPE INTERACTION AND ITS APPLICATION TO THE G_A/G_V RATIO IN β-DECAY HE ANOMALOUS MAGNETIC MOMENT OF NUCLEON. O.Iso.

. theor. Phys., Vol. 22, No. 1, 62-72 (July, 1959).

he G_A/G_V ratio in β-decay and the anomalous nucleon magnetic nt are calculated on the basis of the compound model in which ementary strong interactions are assumed to be the variant scalar, pseudoscalar and tensor Fermi type couplings. model the P-invariance of strong interactions and the equality vector coupling constant of β-decay to that of μ—e decay are automatically, and the experiment proposed by Gell-Mann is to be useful as a test of the composite model.

539.11

234 STRONG INTERACTIONS AND ISOBARIC GAUGE INVARIANCE. V.Gupta.

ar Phys., Vol. 18, No. 1, 149-52 (Aug. (1), 1960).

sobaric gauge invariance of the free fermion Lagrangian is nded and it is shown that it is possible to introduce the pion and its pseudoscalar and pseudovector couplings under a icted gauge transformation. It is also possible to introduce the r coupling in a similar way. The removal of the restrictions gauge would require the introduction of additional interaction s.

539.11 : 539.12

235 INVARIANCE UNDER ANTIUNITARY OPERATORS. G.Feinberg.

. Rev., Vol. 120, No. 2, 640-2 (Oct. 15, 1960).

t is shown that for transitions between "weakly interacting" s, the transition matrix $\mathcal{T}$ can be expressed in terms of a itean operator $\mathcal{T}+\mathcal{T}^\dagger$, and so invariance of the Hamiltonian antiunitary operators such as T or TCP implies invariance nsition rates under kinematic transformations, without chang- e direction of time. An application is made to π^0 decay into 2 ns, where it is shown that invariance under TCP alone implies ity in the number of left and right circularly polarized photons, art in 10^4.

539.11

236 SPACETIME OF THE ELEMENTARY PARTICLES. R.Finkelstein.

th. Phys. (New York), Vol. 1, No. 5, 440-51 (Sept.-Oct., 1960).

The possibility is examined that physical space is characterized torsion, or an asymmetric connection, which is determined by atter field. There exists a space with uniform torsion with the metrical properties as conventional microspace; it is isotropic omogeneous with a very large radius of curvature ($R \cong 10^{28}$ cm). nomentum operators form a group and for practical purposes ute. The torsion defines at every point two kinds of parallel fer or two screw motions of opposite helicity. There are, quently, two kinds of spinor field associated with the space; are distinguished by opposite coupling to the torsion. Viewed within the Lorentz group the torsion produces an axial vector action. To interpret the given mathematical model, it is sted that there exists a universal axial vector coupling between ons represented by the spinor fields and bosons associated with the torsion; and that this interaction manifests itself macroscopically as a torsion of space, in the same general way that gravitational interactions correspond to a curvature of space. This general assumption leads to cosmological models characterized by relations connecting the average density of matter and the strength of the assumed interaction. For the observed average density of matter in the known universe ($\sim 10^{-30}$ g.cm^{-3}) the proposed axial vector coupling turns out, for a space of uniform torsion, to be of the order of the strong interactions.

539.11

17237 A NOTE ON THE FUNDAMENTAL SYMMETRY OF ELEMENTARY PARTICLES. T.Okabayashi.

Progr. theor. Phys., Vol. 21, No. 4, 653-5 (April, 1959).

It is shown that, if all leptons and baryons are taken to be the same, then the only four-fermion interactions which are invariant under time reversal are V and A. A possibility that this might be the explanation of the observed V-A character of the weak interactions is discussed. E.J.Squires

539.11

17238 QUANTIZATION OF THE INTERNAL MOTION OF RELATIVISTIC FLUID MASSES.

P.Hillion and J.P.Vigier.

Cahiers de Phys., Vol. 14, 109-18 (March, 1960). In French.

Elementary particles are represented as distinct states of motion of a rotating fluid droplet. The theory is shown to give a classification for elementary particles, including leptons and photons, analogous to that introduced by Nishijima and by Gell-Mann. (See also Abstr. 3707-10 of 1958). R.A.Newing

539.11

17239 ON LINEARISATION OF THE RELATIVISTIC HAMILTONIAN. K.C.Kar.

Indian J. theor. Phys., Vol. 6, No. 2, 65-7 (June, 1958).

It is shown that the relativistic Hamiltonian for a free electron in an assembly is a vector and so can be linearized directly without introducing unnecessary complications of Dirac matrices.

539.11

17240 NOTE ON THE LINEARISATION OF THE RELATIVISTIC HAMILTONIAN. K.C.Kar.

Indian J. theor. Phys., Vol. 6, No. 4, 107-9 (Dec., 1958).

The relativistic Hamiltonian has been linearized by a perfectly logical wavestatistical method without introducing Dirac matrices at any stage.

539.11

17241 ON THE TRANSFORMATION PROPERTIES OF THE DIRAC EQUATION. P.Y.Pac.

Progr. theor. Phys., Vol. 21, No. 4, 640-52 (April, 1959).

In connection with two types of three-dimensional rotation groups, which are termed in this paper as the helicity and the pseudohelicity group respectively, a synthesis and generalization of the Foldy—Wouthuysen—Tani transformation and the Cini—Toushek transformation for the Dirac Hamiltonian is discussed. One is thus enabled to comprehend in one model the extreme-non-relativistic and the extreme-relativistic limits of the behaviour of free Dirac particles. Moreover, the parity-conserving and the parity-non-conserving interactions of the V—A form are derived on the basis of the invariance of the interaction Hamiltonian for the continuous group of transformations corresponding to the extreme-relativistic case.

539.11

17242 MASS INVERSION AND SOLUTIONS OF THE DIRAC EQUATIONS. K.H.Tzou.

J. Phys. Radium, Vol. 20, No. 12, 933-6 (Dec., 1959). In French.

In Dirac's theory, solutions generated by the mass reversal operation M and by the operators MG are identified, G being the symmetry group {I,P,T,C, and combinations}.

539.11

17243 ON THE INTRINSIC PAULI PRINCIPLE. W.Królikowski.

Nuclear Phys., Vol. 17, No. 3, 421-3 (July (1), 1960).

It is pointed out that the absence of higher spins and multiple charges for elementary particles may be a consequence of a fundamental principle, which plays here a similar role to that of the Pauli principle in atomic physics. A realization of such an "intrinsic Pauli principle" for isobaric properties of elementary particles is given.

539.11

17244 BARYON MASS SPECTRUM. K.Tanaka.

Phys. Rev., Vol. 119, No. 4, 1436-42 (Aug. 15, 1960).

It is assumed that the π—baryon interactions are universal and the K—baryon interactions account for the large mass differences between baryons If further all baryon spins are $\frac{1}{2}$ and K spin is zero, (Σ, Λ) parity is even, the (Σ, Λ) mass difference can be neglected, and the present baryon spectrum and its isotopic spin assignments are correct, then to all orders in the π—baryon coupling constant and to the second order in the K—baryon coupling constants, one can obtain the essential feature of the observed mass spectrum. The magnitudes of the K-coupling constants that yield this mass spectrum are crudely estimated.

539.11

17245 BARYON MASS SPECTRUM. H.Katsumori and K.Shimoura.

Progr. theor. Phys., Vol. 20, No. 4, 578-80 (Oct., 1958).

In a previous paper (Abstr. 12845 of 1960) it was shown that the correct baryon mass level ordering could be obtained from the lowest-order self-energy due to the charge-independent strong interactions. In this note a quantitative estimate is made of the mass level spacings assuming a direct K field coupling. A consistent agreement with experiment is found for a reasonable choice of K—N coupling constant and cut off parameter. J.S.Dowker

539.11

17246 NEW EQUATION OF SPIN $\frac{1}{2}$ PARTICLES AND ISOMORPHISM BETWEEN VARIOUS TRANSFORMATIONS. Z.Tokuoka.

Progr. theor. Phys., Vol. 21, No. 3, 471-3 (March, 1959).

Discusses the isomorphism of Pauli transformations to rotations and gauge transformations, and corresponding results for a certain new equation. R.J.N.Phillips

539.11

17247 ON THE WAVE FUNCTIONS OF HIGHER SPIN PARTICLES. S.Hori.

Progr. theor. Phys., Vol. 21, No. 4, 613-24 (April, 1959).

The 2s + 1 mutually orthogonal wave-functions of a particle with spin s are explicitly worked out in the tensor formalism for a boson and in the Rarita—Schwinger formalism for a fermion, respectively. As an example of application, a method is described according to which an angular correlation function is calculated relativistically, in the case of an associated production of a hyperon and a K-meson and their ensuing decays, assuming that they have higher spins.

539.11

17248 TWO-POINT FUNCTION IN NONLINEAR SPINOR THEORY. H.Mitter.

Z.Naturforsch, Vol. 15a, No. 9, 753-8 (Sept., 1960). In German.

The propagation function of a nonlinear spinor theory with γ_5-invariance is studied in an approximation which neglects four-point and higher correlations. The resulting nonlinear differential equation is solved. The only solution fulfilling certain general physical requirements (microcausality, positive energies) corresponds to a "dipole ghost" of zero rest mass.

539.11 : 539.12

17249 GENERALIZED ISOBAR MODEL, AND THE PIONIC FORM FACTOR OF THE NUCLEON. W.Selove.

Phys. Rev. Letters, Vol. 5, No. 4, 163-5 (Aug. 15, 1960).

In order to explain some of the observed features of pion production in high energy nucleon—nucleon collisions an isobar model is assumed for the process, generated by the exchange of one pion between the incident nucleons. The momentum dependence of the pion propagator is such as to suppress the appearance of the higher mass isobars, and of double isobar production, which might otherwise be expected. More favourable experimental conditions would occur with high energies and small angles for the inelastically scattered nucleon. R.F.Peierls

539.11

17250 TOMONAGA'S INTERMEDIATE COUPLING THEORY USING CONFIGURATION SPACE METHODS. K.L.Nagy.

Acta phys. Hungar., Vol. 9, No. 1-2, 23-48 (1958).

Disregarding pair creation, the state vector of the real nucleon and mean values of some physical quantities are calculated, and the nucleon recoil is considered. W.A.Hepner

17251 AN IMPROVED APPROXIMATION FOR SCATTE PROBLEMS. P.Swan.

Nuclear Phys., Vol. 18, No. 2, 245-70 (Aug.(2), 1960).

A method for calculating the scattering phase-shift in ato and nuclear collision problems is developed. In the limit of h collision energies the method reduces to a second Born appro mation for the phase-shift and for low energies to the shape i pendent formula. The accuracy attained is an order of magnit better than the first or second Born approximations, due to th distortion of the wave-function of the scattered particle by the tential well being allowed for in a simple manner. The method over the whole range of energies and involves one extra integ besides the first Born approximation integral. No multiple in are needed as in higher Born approximations. A detailed com son is made between numerical results at a number of energie for S^3 and S^1 neutron—proton scattering by four central potent phase-shifts being computed on the C.S.I.R.A.C. digital compu numerical solution of the wave equation, by the Born approxim and by the new method. It is found that the method gives best for short-tailed potentials. Many-body scattering phenomena treated with the same degree of simplification. Charged parti scattering is also considered and the corresponding shape inde dent formula derived. The latter is tested on S^1 proton—proto scattering. An improved formula for binding energies, not inv any undetermined variational parameters, is obtained and test the deuteron.

539.11 :

17252 BOUNDS ON SCATTERING PHASE SHIFTS: STAT CENTRAL POTENTIALS. L.Rosenberg and L.Spr

Phys. Rev., Vol. 120, No. 2, 474-82 (Oct. 15, 1960).

It has recently been shown that rigorous upper bounds on scattering lengths can be obtained by adding to the Kohn variati expression certain integrals involving approximate wave-functi for each of the negative-energy states. For potentials which va identically beyond a certain point, it is possible to extend the method to positive-energy scattering; one obtains upper bounds $(-k \cot \eta_l)^{-1}$, where η is the phase shift. In addition to the negat energy states one must now take into account a finite number of states with positive energies lying below the scattering energy. states in this associated energy eigenvalue problem are defined the imposition of certain boundary conditions on the wave-functi A second approach, involving an associated potential-strength eigenvalue problem, is also used. The second method includes first as a special case and, more significantly, can be extended scattering by compound systems. Is some states are not accou for, a bound on cot η is not obtained; nevertheless it is still pos to obtain a rigorous lower bound on η. Upper bounds on η may be obtained, but in a way which is probably not too useful for ma body scattering problems.

53

17253 ON THE ANALYTIC PROPERTIES OF PARTIAL WAVE AMPLITUDES IN YUKAWA POTENTIAL SCATTERING. D.I.Fivel and A.Klein.

J. math. Phys. (New York), Vol. 1, No. 4, 274-9 (July-Aug., 196

A new proof is given of the dispersion relation for the l th partial wave amplitude when the potential is of the Yukawa form (by obvious extension) a suitable linear combination of such for The requisite analyticity properties are obtained by rewriting th integral equation for the quantity $f_l(k, r)$, which is related to the l-wave amplitude, as a Volterra equation on a finite interval in the contribution from the asymptotic part of the integral is absorbed into the inhomogeneous term. The Born series for the inhomogeneous term is analytically continued termwise into the complex wave number plane and the uniform convergence of the series is then established utilizing approximations which apply the asymptotic region. The properties of $f_l(k, r)$ then follow fro well-known theorem on Volterra equations.

53

17254 ANALYTIC PROPERTIES OF RADIAL WAVE FUNCTIONS. R.G.Newton.

J. math. Phys. (New York), Vol. 1, No. 4, 319-48 (July-Aug., 196

This is a review article about the properties of radial wave functions and other quantities relevant to the partial wave analys of scattering theory, as functions of the energy or wave number. The treatment is restricted to the nonrelativistic Schrödinger equation for two particles with a local potential. In addition to regular and irregular solutions of the radial differential equatio

t function, S matrix and Green's functions are analysed and
teness is proved. The examples investigated in detail include
gmann potentials and their generalizations.

539.11

55 MANDELSTAM REPRESENTATION FOR THE LADDER APPROXIMATION OF THE BETHE—SALPETER ALISM. G.Wanders.

Cimento, Vol. 17, No. 4, 535-46 (Aug. 16, 1960).
Mandelstam representation is shown to exist for each term
ladder approximation of the scattering amplitude, in the
ant Bethe—Salpeter formalism.

539.11

256 ON THE INDEFINITE METRIC IN THE LEE MODEL.

E.Kazes and C.Kaufman.

Cimento, Vol. 17, No. 4, 616-18 (Aug. 16, 1960).
ows that the metric operator in the Källén—Pauli treatment
unique, but that this freedom does not affect the interpretation
ttering. R.J.N.Phillips

539.11 : 539.14

ARITY NONCONSERVING INTERNUCLEON POTENTIALS.
CTS IN ELECTROMAGNETIC TRANSITIONS. See
17461

539.11

257 SUBTRACTIONS IN FORWARD SCATTERING DISPERSION RELATIONS. H.Chew.

Cimento, Vol. 17, No. 4, 619-22 (Aug. 16, 1960).
he author claims that the possibility whether all physical
tudes may not satisfy dispersion relations which do not require
btractions may be excluded empirically for the pion—nucleon
rd scattering amplitude, on the basis of the present experimen-
ta. The expression $D_+(E) + D_-(E)$, (where $D_\pm(E)$ denote the
parts of the $\pi^\pm$—p forward scattering amplitudes at incident
ab energy, E) is evaluated at zero pion kinetic energy, in terms
zero-energy scattering lengths a_1 and a_2. It is shown that the
alue of this expression contradicts that given by estimating the
of the unsubtracted dispersion relations using the experiment-
a. J.H.Gunn

539.11

258 DISPERSION RELATIONS FOR SCATTERING WAVE FUNCTIONS IN POTENTIAL THEORY. B.Bosco.

o Cimento, Vol. 17, No. 4, 558-79 (Aug. 16, 1960).
Using the well known analytic properties of partial wave-
ions, dispersion relations are derived which can be transformed
itarity into singular integral equations. In absence of bound-
s a procedure is given which allows one to determine, order by
r, the wave-function when the S-matrix is known at every
r. An intuitive deduction of dispersion relations for the case
ite range potential based on the completeness relation is also
rted. This result allows the derivation of dispersion relations
ne transition matrix elements.

539.11

7259 INVARIANCE AND THE S-MATRIX.

S.Kamefuchi and Y.Takahashi.

ear Phys., Vol. 17, No. 4, 686-94 (July (2), 1960).
The transformation property of the state vector in the interac-
picture is examined. The invariance condition is relaxed by
ring the invariance of the S-matrix only.

539.11

260 A NOTE ON SCATTERING AND PRODUCTION AMPLITUDES. A.P.Balachandran and N.R.Ranganathan.

ear Phys., Vol. 18, No. 1, 81-4 (Aug. (1), 1960).
A relation between scattering and production amplitudes for
esses involving an arbitrary number of final channels was
ved at following a method due to Sucher and Day. Possible
cations of this equation to π—π, K—K and $\pi + \pi \rightarrow K + K$
terings are pointed out. Also a simple and exact expression
he γ—γ scattering amplitude in terms of the amplitude for the
ess $\gamma + \gamma \rightarrow e^- + e^+$ was obtained.

539.11

7261 CAUSALITY AND DISPERSION RELATIONS FOR FIXED MOMENTUM TRANSFER. H.M.Nussenzveig.

ica, Vol. 26, No. 4, 209-28 (April, 1960).
In order to investigate which physical assumptions are relevant
e validity of dispersion relations for fixed momentum transfer,
nple case is treated: the scattering of a classical scalar field
by an arbitrary spherically symmetric scatterer of finite radius. It is sufficient to assume: (a) restrictions, due to causality, on the propagation of signals with sharp fronts; (b) conditions on the behaviour of the phase-shifts in the low-frequency and high-angular-momentum limits. To relate the scattering amplitude for fixed momentum transfer to the principle of strict causality, a new representation for this amplitude, in terms of the scattered wave at finite distances from the scatterer, is introduced. The dispersion relations are rigorously derived from the basic assumptions. The results are partially extended to the scattering of Schrödinger particles. An explicit example (totally reflecting sphere) is treated as an illustration.

539.11

17262 LIMITATIONS TO DISPERSION RELATIONS.

J.G.Taylor.

Ann. Phys. (New York), Vol. 10, No. 4, 516-35 (Aug., 1960).

An attempt is made to understand the limitations to the validity of dispersion relations by considering fourth-order terms for elastic scattering in perturbation theory. For the exchange scattering of equal mass, scalar, neutral bosons, $\Delta^2_{max} = 2m^2$ is obtained for the limit of the validity of the general proof, but closer inspection shows that the dispersion relation is satisfied by this diagram for all values of the momentum transfer Δ. This is also the case for nucleon-nucleon exchange scattering. It is concluded that the general limitations on Δ^2 have arisen from natural examples, and that the method of proof using analyticity in the mass of the projectile particle must be extended considerably to enable such examples to be considered. No general limitations on Δ^2 arise from the direct scattering term in fourth order, but do so when anomalous thresholds are allowed. It does not seem possible to use the general method of proof in this case.

539.11

17263 TWO-NUCLEON L·S POTENTIAL IN PSEUDOSCALAR MESON THEORY. C.K.Iddings and P.M.Platzman.

Phys. Rev., Vol. 120, No. 2, 644-52 (Oct. 15, 1960).

Nonstatic corrections to the two-nucleon potential of Brueckner and Watson and of Gartenhaus are computed within the framework of the γ_5 theory. These terms appear as spin-orbit corrections of order μ/M to the static potentials. The S matrix is calculated in second and fourth order for a reduced form of the relativistic theory. The potential is then chosen so as to duplicate this S matrix to the required order in the coupling constant and μ/M. The extent to which this reduction of the γ_5 theory changes its character is considered. The resulting potentials are given in analytic form for no cutoff in momentum space and in numerical form for the Gaussian cutoff employed by Gartenhaus. Some additional static corrections are also given to previous potentials. A qualitative comparison is made with the experimental observations in nucleon—nucleon scattering, the fine structure in the splitting of the He^5 nucleus, and the contribution of the nonstatic potential to the magnetic moment of the deuteron.

539.11

17264 ON THE RELATION BETWEEN THE PHASE SHIFT AND THE NUMBER OF BOUND STATES. M.Ida.

Progr. theor. Phys., Vol. 21, No. 4, 625-39 (April, 1959).

Some features of the Low equation (Abstr. 3453 of 1955) are studied for Dyson's model. To select a unique solution the relation between the phase shift and the number of bound states is important. This relation is investigated more generally. It is connected with the energy spectra of the free Hamiltonian. The relation between the phase shift and the number of resonant states is also shown. Resonances are classified into two types and some differences in their properties are stated.

539.11

17265 APPROXIMATE SOLUTION OF THE RELATIVISTIC TWO-BODY EQUATION AND ITS APPLICATION TO THE NUCLEAR FORCES. H.Yamamoto.

Progr. theor. Phys., Vol. 22, No. 1, 73-88 (July, 1959).

The approximate but analytical solutions of the Bethe—Salpeter equation (Abstr. 1469 of 1952) are given and the relations between binding energy and coupling constant are obtained. With the use of these solutions the validity of the non-relativistic approximation (i.e., neglect of retardation and recoil) is investigated.

539.11

17266 ORDINARY AND ANOMALOUS THRESHOLDS IN PERTURBATION THEORY. N.Nakanishi.

Progr. theor. Phys., Vol. 22, No. 1, 128-44 (July, 1959).

Ordinary and anomalous thresholds of the matrix element corresponding to the general Feynman graph are rigorously investigated in detail. Necessary conditions for the ordinary threshold are obtained.

539.11

17267 THE MEAN-WAVE IN A SYSTEM OF PARTICLES IN THE FUNCTIONAL THEORY. F.Aeschlimann.

J. Phys. Radium, Vol. 20, No. 12, 927-32 (Dec., 1959). In French.

Some principles of the functional theory of particles and the properties of the centre of masses are discussed. The definitions of mean-waves and sum-wave are given, in particular the mass-mean-wave (which corresponds to the centre of masses) and the uniform-mean-wave. The global properties of a system can be expressed with these waves.

539.11

17268 TREATMENT OF SPECIAL TRANSLATIONALLY INVARIANT THREE-BODY PROBLEMS BY ADAPTED COORDINATES. P.Möbius.

Nuclear Phys., Vol. 18, No. 2, 224-44 (Aug.(2), 1960).

An attempt is made to compute the wave-functions of the considered examples as functions of adapted coordinates which are appropriately chosen combinations of the particle coordinates. The purpose of introducing the adapted coordinates is to satisfy automatically most of the conditions which exist for a many-body wave-function. The fully classified and antisymmetrized wave-function is written as a linear combination of products of space, spin and isobaric spin functions. The concept of one-particle functions and Slater determinants is completely eliminated. Several examples with translationally invariant interactions are treated, one containing a repulsive core.

539.11

17269 ON THE ENERGY GAP OF THE DILUTE FERMI GAS FOR NEGATIVE TWO BODY SCATTERING LENGTH.

D.S.Falk and T.W.Ruijgrok.

Physica, Vol. 26, No. 4, 266-8 (April, 1960).

Van Hove (Abstr. 15301 of 1960) has pointed out certain difficulties in the application of perturbation theory to a dilute gas of Fermi particles with a negative two body scattering length. It is shown here that these difficulties may be circumvented if one pertubs, not from the non-interacting ground-state, but rather from some other ground-state. It is a necessary and sufficient condition that the new unperturbed system exhibits an energy gap or gap-like behaviour in its ground-state. For certain systems this implies that the true ground-state must exhibit the same properties.

539.11

17270 REACTION MATRIX SINGULARITIES AND THE ENERGY GAP IN AN INFINITE SYSTEM OF FERMIONS.

V.J.Emery.

Nuclear Phys., Vol. 19, No. 2, 154-63 (Oct. (1), 1960).

It is shown that the presence of a singularity in Brueckner's t-matrix for an infinite system of fermions is a sufficient (but not necessary) condition for the existence of a gap in the energy spectrum of the system. On the other hand there are singularities in Galitskii's t-matrix if and only if the system has an energy gap. Furthermore, there are both singularities and an energy gap if the solution of a Schrödinger equation with modified kinetic energy has a positive phase shift δ at the Fermi momentum. The results are illustrated by deriving approximate expressions for the energy gap and the distances of the singularities from the Fermi surface in terms of the phase shift δ.

539.11 : 536.48

17271 ON A MODIFIED BETHE—GOLDSTONE EQUATION. A.Katz.

Nuclear Phys., Vol. 18, No. 2, 177-95 (Aug. (2), 1960).

A many-fermion system with B.C.S. interaction is treated by a modified Bethe—Goldstone equation which takes into account a self-consistent spreading of the Fermi surface. The method employs a modified wave-function which is an eigenstate of one modified Hamiltonian and from which energies are determined by another. Pairs with total momentum 0 are treated as elementary entities. All modifications are achieved by a "projection operator" which a priori takes care of the interference between pairs due to their statistics. The only case solved is the one where all interacting pairs go into the Cooper state of the modified Hamiltonian. The results are identical with those of Bardeen et al.

5

17272 ON THE PROBLEM OF REARRANGEMENT ENER OF NUCLEAR MATTER. P.Mittelstaedt.

Nuclear Phys., Vol. 17, No. 3, 499-515 (July (1), 1960).

The rearrangement energy of the nuclear many-body probl (e.g. a system of nucleons) which is important in the processes separation, scattering and excitation of a particle, is investigat To discuss the physical meaning of this quantity, a general definition, independent of perturbation theory, is given. The "m dependence" and other important properties can then be discus in detail. Starting from this general formulations expressions the rearrangement energy in the Brueckner two-particle approx tion are derived, and the question of how the rearrangement ene can be determined experimentally is discussed.

ELEMENTARY PARTICLES

53

17273 ELEMENTARY PARTICLES OF MODERN PHYSICS R.E.Marshak.

Science, Vol. 132, 269-74 (July 29, 1960).

Review article. The properties of particles and antipartic their forces and conservation laws are summarized.

53

17274 MASSLESS PARTICLES. R.H.Good, Jr.

Amer. J. Phys., Vol. 28, No. 7, 659-66 (Oct., 1960).

This paper gives a discussion of massless particles, especi the two-component neutrino and the photon, in the light of moder ideas about space reflection. The emphasis is on the physical a ments and mathematical details are omitted.

53

17275 ON PARITY NONCONSERVATION. T.Tati.

Progr. theor. Phys., Vol. 20, No. 3, 398-400 (Sept., 1958).

A phenomological study of elementary particle decays sugge a model which accounts for the parity conserving and parity non conserving reactions. An analogy is drawn between the structur of d and l isomers in stereochemistry and the structure of the f factor of the basic four fermion weak interaction. Field theoret implications are discussed. J.S.Do

53

17276 CALCULATION OF THE G FACTOR FOR GAS SCATTERING EXPERIMENTS. E.A.Silverstein.

Nuclear Instrum. and Methods, Vol. 4, No. 2, 53-66 (March, 195

In gas scattering experiments a beam traverses the target and scattered particles enter the detector through a system consisting of two apertures in parallel planes. The "G factor", rel ting the yield to the beam intensity, target density, and scatteri cross-section is calculated for several types of aperture bound (Geometrical effects only are considered; slit edge and multiple scattering are ignored). The case of a front aperture compose two parallel edges of infinite height with a rear (detector) apert of any shape is calculated up to terms in the fourth derivative o the cross-section. Effects of the finite diameter of the beam ar also included. For a circular front and rear aperture the G fac involves elliptic integrals. The extra calculation in design of s a system is considered worthwhile, since a pair of circular apertures should be simpler to make and align.

53

17277 PENETRATION OF CHARGED PARTICLES IN MAT

Nature (London), Vol. 187, 1086 (Sept. 24, 1960).

An account of published proceedings of an informal confere held under the above title at Gatlinberg, Tennessee, Sept., 1958. The conference was organized by a subcommittee of the Nationa Academy of Sciences — National Research Council and sponsor by the U.S. Atomic Energy Commission, National Science Found and the Air Force Office of Scientific Research. The papers ar presented under the headings: stopping power and range, recen developments in the theory of stopping power, charge-changing collisions, atomic and molecular scattering, ionization in gases high energy particles, and microscopic and macroscopic energy-loss distributions.

539.12 : 537.534
NERGY LOSS OF He^4 IONS IN NICKEL FOIL, GASEOUS
EN AND NUCLEAR EMULSIONS. See Abstr. 17051

539.12 : 539.18 : 539.19
GROUND STATE OF SYSTEMS OF THREE PARTICLES WITH
OMB INTERACTION. See Abstr. 17806

539.12 : 539.17
NEW TYPE OF ANGULAR-DISTRIBUTION CHAMBER.
bstr. 17577

ons

539.12

278 POLARIZATION EFFECTS IN THE ELASTIC SCATTERING OF PHOTONS.

schini, D.S.R.Murty and P.Veronesi.
Cimento, Vol. 15, No. 5, 847-9 (March 1, 1960).

he result is described of a measurement of the polarization of
MeV γ-rays, elastically scattered from a 3 cm Hg target at an
of 53°, which is the angle of maximum polarization predicted
theory of Brown and Mayers (Abstr. 678 of 1958). A success-
ompton scatter, in a NaI (Tl) crystal which also detected the
l electrons, was used as a polarization analyser, the scattered
s being detected in coincidence in a further NaI (Tl) crystal.
y discrimination was used to select elastic events. The result
ed is in very good agreement with the theory of Brown and
rs and differs significantly from the prediction of Franz (Abstr.
1936). J.D.Dowell

539.12 : 539.18
POLARIZATION OF PHOTONS ELASTICALLY SCATTERED
ERCURY ATOMS. See Abstr. 17692

539.12

279 THE SUM—COINCIDENCE METHOD AND ITS APPLICATION TO GAMMA-RAY SCINTILLATION
TROSCOPY. A.M.Hoogenboom.

ear Electronics Conference, Paris, 1958. Vol. I. (see Abstr.
of 1960) 127-36.

For detecting double cascades, a two-crystal scintillation spec-
eter is used. The two detected gamma-rays are added linearly
he amplified sum pulse is fed to a differential discriminator,
is adjusted so that an output pulse appears only if both gamma
are fully absorbed in the crystals. The pulses from one crystal
nalysed by a multi-channel analyser which is gated open by the
output pulses. The coincidence spectrum thus shows only the
energy peaks, with a peak due to the absorption of both gamma
a in one crystal. Spectra obtained from a number of different
ces are illustrated. Extensions of the method to angular cor-
ion measurements and the detection of triple cascades are also
ibed. W.G.Stripp

539.12

7280 SCINTILLATION SPECTROMETER WITH CONSTANT RELATIVE CHANNEL WIDTH. B.Åström.

ear Instrum., Vol. 1, No. 3, 143-7 (May, 1957).

It is shown that many of the difficulties involved in making
natic recordings of the γ-spectra measured with a scintillation
trometer can be eliminated by using a pulse amplitude discrim-
r with a varying channel width. The circuit of such a discrim-
r is given. It is also shown how γ-intensity ratios can be
ated from different types of measurements.

539.12 : 621.374.32

7281 A MULTI-CHANNEL GAMMA-RAY SPECTROMETER WITH AUTOMATIC COMPTON OR BACKGROUND
RACTION. D.M.C.Thomas and W.J.Callow.

ear Electronics Conference, Paris, 1958. Vol. I. (see Abstr.
of 1960) p.117-26

The spectrometer uses a NaI:Tl crystal, with Compton
ibution compensation by subtraction of the spectrum of an
acene crystal. A gated cathode-follower passes the photo-
plier outputs to a common amplifier and a modified Hutchinson
rott analogue-to-time converter, feeding an adder, storage and
ay system. 93 channels, each 0.4 V wide, with a capacity of 16
y digits, are available. The add—subtract function may be
rsed only during the time between a pulse being cleared from
onverter and the arrival of the next pulse at the input.
W.G.Stripp

539.12

17282 PHOTOGRAPHIC BENT CRYSTAL GAMMA SPECTROMETER. O.Beckman.

Nuclear Instrum., Vol. 3, No. 1, 27-32 (July, 1958).

A 1 m bent crystal gamma-ray spectrometer is described. The gamma lines are registered on Ilford G5 nuclear emulsions. By counting with a microscope the electron tracks forming a line, it is possible to determine gamma intensities. Corrections have to be made for emulsion efficiency, crystal reflectivity and the geometry of the spectrometer. The accuracy of this method is controlled by the measurements of some known lines in Ta^{182}. In addition, the energies and intensities of two lines in Sm^{153} are given: 69.66 ± 0.02 keV and 103.18 ± 0.04 keV; intensity ratio 9 to 100.

539.12

17283 SIX-METER RADIUS BENT-CRYSTAL SPECTROGRAPH FOR NUCLEAR GAMMA RAYS.

A.H.Kazi, N.C.Rasmussen and H.Mark.
Rev. sci. Instrum., Vol. 31, No. 9, 983-7 (Sept., 1960).

A spectrograph for the precision measurement of nuclear gamma-ray wavelengths has been designed, constructed, and placed into operation at the Massachusetts Institute of Technology. This instrument is particularly well suited for directly measuring neutron capture gamma rays produced by samples placed in the through port of the MIT research reactor. The spectrograph is designed to measure wavelengths of gamma rays in the energy region from 0.1 to 4.0 MeV with an estimated precision that varies from about 0.01% at 0.1 MeV to 0.3% at 4 MeV. Photographic methods are used to record the gamma-ray lines on the focal circle. A bent crystal is used to diffract and focus the gamma rays. Line width and efficiency data have been obtained for the (310) (003), and (006) planes of quartz. The efficiency of the instrument is quite low. In order to record a line at 2.0 MeV an exposure time of about 6000 curie hours is required.

539.12

17284 A HIGH ENERGY GAMMA RAY SPECTROMETER. R.Gabriel, E.L.Garwin and C.M.York.

Nuclear Instrum. and Methods, Vol. 5, No. 4, 247-53 (Oct., 1959).

A gamma-ray spectrometer for use in the energy range 50 to 150 MeV is described. The spectrometer employs a rather conventional lead glass Cherenkov counter in coincidence with a scintillation-counter telescope as a detector. The circuits which detect and analyse the gamma-rays are of simple and reliable design, and use only crystal diodes and switching transistors as their active elements. The results of a calibration experiment using an electron beam are presented to demonstrate the performance of the apparatus.

539.12 : 621.374.32

17285 A GAMMA RAY SPECTROMETER FOR ENERGIES UP TO 1 GeV.

M.Beneventano, U.Pellegrini, B.Rispoli, G.C.Sacerdoti, P.G.Sona and R.Toschi.
Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p.107-16

A detailed description of the magnet and target design for the spectrometer, which was under construction. The pole pieces are trapezoidal, with widths of 1100 mm and 300 mm. Water-cooled copper coils with 120 turns and a maximum current of 2100 A, stabilized to 0.1%, give a max. flux density in the 100 mm gap of 2Wb/m^2. In the upper pole 36 holes are drilled to enable scintillation counters to be inserted. Electron pairs of equal energy are detected by two different three-fold coincidences, and by prompt and delayed coincidence circuits, which are also described.
W.G.Stripp

539.12 : 539.1.07

17286 A γ-RAY COLLIMATOR AND EXPANSION CHAMBER FOR USE WITH THE 340 MeV ELECTRON SYNCHROTRON.

J.R.Atkinson, W.McFarlane, J.M.Reid and P.Swinbank.
Nuclear Instrum., Vol. 1, No. 3, 152-8 (May, 1957).

This paper describes a collimator and Wilson type expansion chamber used at Glasgow University for the study of nuclear photodisintegration. The collimated beam has a diameter of 2.0 cm in the beam room, 6 metres from the machine target. The beam room is shielded against background radiation from the machine by a lead and concrete screen. The cloud chamber control system is very flexible and allows chamber and machine operations to be accurately synchronized.

539.12 : 539.2

17287 GALLIUM ARSENIDE FOR γ-RAY SPECTROSCOPY. W.R.Harding, C.Hilsum, M.E.Moncaster, D.C.Northrop and O.Simpson.
Nature (London), Vol. 187, 405 (July 30, 1960).

GaAs may be prepared with a resistivity greater than 10^6 ohm cm. When a bar of this material is bombarded with γ-radiation, charge pulses are observed. The pulses have a rise-time of about 5 μsec and a height of 0.5 mV when the applied field is 200 V/cm. Such crystal conduction counters offer advantages over ionization chambers or scintillation counters for nuclear spectroscopy. C.Hilsum

539.12

17288 VACUUM DEPOSITION OF URANIUM ON THIN ORGANIC BACKINGS FOR NUCLEAR SPECTROSCOPIC USE. P.Erman and W.Parker.
Nuclear Instrum. and Methods, Vol. 5, No. 2, 124-6 (Aug., 1959).

A method has been developed for the preparation of uranium converters for use in high resolution gamma spectroscopy. Vacuum deposition was found to be preferable because homogeneous films can be obtained on organic backing materials. The present method enables metallic uranium converters to be produced with a thickness up to 2 mg/cm^2.

539.12

17289 A γ-RAY DIRECTIONAL DETECTOR. D.Veron.
J.Phys. Radium, Vol. 19, Suppl. No. 12, 129A-132A (Dec., 1958). In French.

This apparatus was designed for the investigation of a small source. It consists of two photomultipliers connected in opposition and separated by a lead shield.

539.12

17290 A SIMPLE THEORY OF BREMSSTRAHLUNG WITHOUT DIRAC MATRICES. K.C.Kar and B.N.Paria.
Indian J. theor. Phys., Vol. 5, No. 4, 81-95 (Dec., 1957).

The relativistic differential cross-section for Bremsstrahlung is deduced without using Dirac's non-commutative matrices and hence avoiding lengthy and tedious "spur" calculations. The linear form of Hamiltonian as given by Kar and Sanatani (Abstr. 5296 of 1954) and the simple multiplication rules of vectors are used.

539.12

17291 BREMSSTRAHLUNG SPECTRA CORRECTED FOR MULTIPLE SCATTERING IN THE TARGET.
B. NUMERICAL DATA AND DISCUSSION. E.Hisdal.
Arch. Math. Naturvid., Vol. 54, No. 3, 15 pp.(1957).

For Pt A, see Abstr. 5396 of 1957. The shape of the bremsstrahlung spectrum in the forward direction is calculated taking into account the multiple scattering of the incident electrons in the target before they emit the bremsstrahlung quanta. Tables of the spectra for various incident electron energies are given. C.J.Batty

539.12

17292 RADIATION FROM PARTICLES EXCEEDING THE VELOCITY OF LIGHT AND SEVERAL APPLICATIONS OF IT IN EXPERIMENTAL PHYSICS. P.A.Cerenkov [Cherenkov].
Sci. and Culture, Vol. 25, No. 5, 261-6 (Nov., 1959).

X-rays

539.12

17293 USE OF THE "TOTAL EXTERNAL REFLECTION" PHENOMENON IN FILTERING OF THE CONTINUOUS SPECTRUM IN THE ULTRA-SOFT X-RAY REGION.
A.P.Lukirskii and Yu.A.Omel'chenko.
Optika i Spektrosk., Vol. 8, No. 4, 563-8 (April, 1960). In Russian.

Describes the apparatus for recording of the absorption spectra in the ultra-soft X-ray region (around 100 A) using continuous emission sources whose spectra include hard X-rays. The shorter wavelengths are removed by means of the "total external reflection" method, using a quartz or beryllium reflector between the X-ray tube anode and the entry slit of a spectrometer. A.Tybulewicz

5

17294 THE COHERENT SCATTERING OF X-RAYS IN TH
DIRECTION OF THE PRIMARY BEAM. L.P.Hyvä
Ann. Acad. Sci. Fennicae AVI. No. 45, 10 pp (1960).

The problem of forward scattering of X-rays by a homogen
and amorphous slab of matter is treated using two slightly diffe
approaches. The first one utilizes the classical Thomson scatt
amplitude for a free electron and Fresnel diffraction and failed
give acceptable results. The zero-order differaction peak beca
all too strong leading into an impossible result. In this treatm
the multiple scattering was expected to be allowed for by introd
a factor due to interference in the matter and which modifies th
phase velocity. This, however, affects equally the direct as we
as the scattered rays producing no net phase shifts. In the sec
approach the multiple scattering appears as overlapping of cr
section areas in the two-dimensional projection along constant
surfaces. The stamp analogy serves to make the treatment mo
illustrative. The final result indicates that multiple scattering
always destroys the coherent scattering intensity in the forwar
direction or that it cannot be separated from the primary beam
because the final intensity depends exponentially on the thicknes
Finally, it should be pointed out that the result is based on a ra
distribution of electrons and does not hold for ideal crystals wi
anomalous absorption properties explained by the dynamical th
On the other hand, in a polycrystalline sample, where the grain
much smaller than the Fresnel zones, the randomness is well
satisfied and no anomaly is observed.

539.12 : 621.3

17295 EXPERIMENTS WITH A LOW INDUCTANCE HIGH VACUUM X-RAY FLASH TUBE SET.
P.Ohlin and S.Händel.
Ark. Fys., Vol. 17, Paper 9, 157-61 (1960).

A new type of low-inductance X-ray flash tube is described.
low-inductance capacitor was used and the intensity of the X-ra
was studied for different circuit inductances. A new phenomenon
observed; the intensity was shown to depend strongly on the circ
inductance.

53

17296 IMPROVED NaI SCINTILLATION SPECTROMETER
THE STUDY OF CONTINUOUS X-RAY SPECTRA.
G.Hettinger and N.Starfelt.
Nuclear Instrum., Vol. 3, No. 1, 25-6 (July, 1958).

The K X-ray escape fraction of a NaI scintillation spectrom
is essentially reduced by letting the collimated X-rays to be stu
enter through a narrow well in the crystal.

539.12 : 539.2 :

17297 A PRECISION MOUNTING FOR BENDING THE ANALYZING CRYSTAL IN X-RAY AND γ-SPECTROMETERS. H.de Lang.
Physica, Vol. 25, No. 10, 945-53 (Oct., 1959).

The aberrations of a bent crystal are briefly discussed. A
precision mounting is described in which the analysing crystal
bent elastically. The asymmetrical broadening of the spectral
lines is corrected by de Wolffs' method: giving the curvature a
constant gradient in the plane of incidence by exerting unequal
moments on the ends of the crystal. Aberrations due to seconda
curvature are avoided by giving the crystal a toroidal shape. A
optical inspection method to test the bending is described.

539.12 : 539

17298 PRECISION QUANTAMETER FOR HIGH ENERGY X-RAYS. R.R.Wilson.
Nuclear Instrum., Vol. 1, No. 2, 101-6 (March, 1957).

An ionization chamber has been designed to serve as a stan
for measurements of the intensity of beams of high energy phot
The chamber consists of twelve plates of copper, each of 1 cm
thickness, so that nearly all the energy of the photons is absorb
the chamber. The ionization in the shower is sampled at the tw
gaps between plates, and the gap widths are arranged so that a
Simpson's rule integration of the shower curve is automatically
made. By making the last gap larger and by making an appropr
gap at the sides of the chamber, a compensation is made for any
leakage of energy out of the chamber. The total energy content
photon beam, U, should be accurately proportional to the ionizat
charge measured, q, independently of the spectral shape of the
An absolute calibration of the chamber has been calculated to a
accuracy of a few percent. A density effect correction to the st
ping power of copper has been included in the calculation.

539.12 : 621.374.32

299 AN ELECTRONIC APPARATUS FOR THE STUDY OF X-RAYS WITH PROPORTIONAL COUNTER. N.Patla.

. Instrum., Vol. 37, No. 10, 388-93 (Oct., 1960).

'he design and construction of an electronic pulse recording m for use with a proportional counter suitable for X-ray s is described. The performance of the high gain amplifier ulse amplitude analyser for X-ray wavelength discrimination cussed in detail.

rinos

539.12

300 CROSS SECTIONS OF REACTIONS PRODUCED BY HIGH ENERGY NEUTRINO BEAMS.

bibbo and R.Gatto.

Cimento, Vol. 15, No. 2, 304-10 (Jan. 16, 1960).

Possible reactions allowed by lepton conservation are listed for energy neutrinos. An expression is derived for the cross-on of the reaction $\nu + N \rightarrow e + N$ in terms of the nuclear form-rs. Using the non-renormalization hypothesis for the vector geness-conserving current the cross-sections are calculated function of energy. They go to a limit of $\cong 7 \times 10^{-39}$ cm^2 above V. Other interactions (e.g., producing muons, pions and strange cles) would be possible but there is not sufficient information to late their cross-sections. For interactions with electrons the e-of-mass energy is still too low to give measurable cross-ons for 25 GeV neutrinos. A.Ashmore

rons

539.12

7301 SELF-ENERGY AND STABILITY OF THE CLASSICAL ELECTRON. F.Rohrlich.

r. J. Phys., Vol. 28, No. 7, 639-43 (Oct., 1960).

The classical theory of the electron, as proposed by Abraham Lorentz, is usually presented as beset by the difficulty that the entum and velocity of its Coulomb field are incorrectly related natically: $p = \frac{4}{3} m_s v$, where m_s is the electromagnetic mass ed by the electromagnetic self-energy. This problem also per- in the relativistic theory. It is shown here that the difficulty is inated from the relativistic theory by treating the integrals over lectromagnetic field in a relativistic fashion, i.e. taking note of dependence on the motion of the electron. The surface depend- of the integrals representing the electromagnetic momentum energy of the particle is essential and occurs whenever the er tensor is not introduced. The nonrelativistic limit of this ulation then also leads to the correct relationship $p = m_s v$. The ected Abraham—Lorentz theory still contains the stability pro-, but this problem is no longer related to the transformation erties. It can be removed by renormalization.

539.12

7302 A NEW DERIVATION OF KLEIN—NISHINA FORMULA WITHOUT MATRICES. K.C.Kar and B.N.Paria.

an J. theor. Phys., Vol. 5, No. 3, 51-62 (Sept., 1957).

Klein—Nishina formula for differential cross-section of pton scattering, deduced so far only on the basis of Dirac's ry of electron, is derived here by an alternative method without g Dirac's noncommutative matrices and hence avoiding lengthy intricate "spur" calculation. The exact formula for the differ-al cross-section has been uniquely obtained in a perfectly simple straightforward manner. In so doing, the linear form of Hamil-n recently obtained by Kar and Sanatani (Abstr. 5296 of 1954) the ordinary multiplication rules of vectors have been used. physical significances of the different mathematical steps are clearly explained.

539.12

7303 RADIATIVE CORRECTIONS TO THE e—e SCATTERING. Yung Su Tsai.

vo Cimento, Vol. 16, No. 2, 370-2 (April 16, 1960).

Radiative corrections to an e—e colliding beam experiment g 500 MeV electrons are calculated. C.J.Batty

539.12

17304 HIGH-ENERGY ELECTRON—ELECTRON SCATTERING. Yung Su Tsai.

Phys. Rev., Vol. 120, No. 1, 269-86 (Oct. 1, 1960).

The radiative corrections to the electron—electron scattering to order α^3 are calculated for (a) the colliding beam experiment and (b) the experiment in which the target electron is at rest initially. The contributions from high-energy real photons are included. The two-photon exchange diagrams are found to give only negligible contributions to the cross-sections after infrared cancellation. The effect due to the possible breakdown of quantum electrodynamics is discussed. A preliminary study on the electron—positron colliding beam experiment involving various interactions is made. The vacuum polarizations involving heavier particles than an electron pair in the closed loop are investigated.

539.12

17305 ELECTRON—PROTON SCATTERING AT 900 MeV AND 135°. L.N.Hand.

Phys. Rev. Letters, Vol. 5, No. 4, 168-9 (Aug. 15, 1960).

Measurements were made for incident electron energies of 825, 856 and 896 MeV, giving $q^2 = 23.9$, 25.1 and 26.7 f^{-2}. Normalization was effected by taking measurements at 45° and electron energies of 374 and 381 MeV, thus keeping constant geometry. The experimental values of F^2 are in agreement with the exponential model with $a = 0.80$ f. A.Ashmore

539.12

17306 AN APPARATUS FOR MEASURING THE LONGITUDINAL ELECTRON POLARIZATION BY MOTT-SCATTERING.

H.Bienlein, K.Güthner, H.Von Issendorff and H.Wegener.

Nuclear Instrum. and Methods, Vol. 4, No. 2, 79-89 (March, 1959). In German.

The apparatus design is described. The influences of the following are pointed out: electron optical properties, depolarization by self-scattering in the source, passing through magnetic fields, perturbations by scattering from the walls, multi scattering in the scattering foil. The effect of asymmetries of the electron distribution and of finite spherical angles are discussed. As an example measurements with Co^{60} are reported. The result is:

$$P = -(0.93 \pm 0.03)\ v/c.$$

539.12

17307 RESOLUTION AND COLLECTING POWER OF A SPIRAL ORBIT β-RAY SPECTROMETER. A.Burdet.

J. Phys. Radium, Vol. 20, No. 10, 837-9 (Oct., 1959). In French.

The trajectories of charged particles in an axially symmetric magnetic field spectrometer invented by Miyamoto are discussed theoretically for the median plane of the magnet gap. For a 0.5 mm diameter circular source, a collection efficiency of 40% in this plane is predicted with a resolution of 0.65% whilst for a 0.2 mm diameter source a collection efficiency of 80% may be attained with 0.6% resolution. Attention is drawn to the usefulness of this type of β-ray spectrometer for the study of low specific activity sources. A.E.I.Research Laboratory

539.12

17308 EVAPORATION DEVICE FOR BETA-SPECTROMETER SAMPLES. R.Stockendal and K.E.Bergkvist.

Nuclear Instrum., Vol. 1, No. 1, 53-4 (Jan., 1957).

539,12

17309 ON A SET OF PERMANENT MAGNET BETA-RAY SPECTROMETERS. H.Slätis.

Nuclear Instrum., Vol. 2, No. 4, 332-41 (May, 1958).

The advantages of the use of a set of at least three permanent magnet beta-ray spectrometers, each spectrometer designed for a certain energy interval, are emphasized. It is found that a design which gives good homogeneity for strong magnetic fields might fail to do so for weak ones. A simplified construction of high resolution spectrometers is given. Reproductions of conversion line spectra of ThB + C + C'' and of Hg$^{195,\ 195m,\ 197,\ 197m}$ illustrate the efficiency of the spectrometers. The suitability of a high resolution permanent magnet beta-ray spectrometer for use also in the low energy region (about 6-15 keV) is demonstrated by a record of more than 50 L-Auger lines in the electron spectrum of ThB + C + C''.

539.12 : 537.5

17310 THE PRODUCTION OF VERY THIN ELECTRICAL CONDUCTORS. PREPARATION DATA FOR ABSOLUTE β-COUNTING. E.Huster and W.Rausch.

Nuclear Instrum., Vol. 3, No. 4, 213-17 (Oct., 1958). In German.

Absolute β-counting with radioelements of low decay-energy is difficult because of absorption losses in the source and its backing. If moreover the half-life is very high, extended sources are necessary. It has been furthermore shown, that backings must be electrically conducting to prevent charging of the source and thereby distortion of the electric field of the counter, if counting is done with the source in the interior of the counter. A method is described for preparing electrically conducting formvar foils of 85 ± 30 mm with an overall thickness of 10 $\mu g/cm^2$. The conductivity is attained by first exposing the foil to a glow discharge in a hydrocarbon atmosphere and then evaporating silver on it.

539.12

17311 POLARIZATION PHENOMENA FOR POSITRON ANNIHILATION-IN-FLIGHT. W.H.McMaster.
Nuovo Cimento, Vol. 17, No. 3, 395-414 (Aug. 1, 1960).

A method is presented for solving the Dirac equation for the annihilation of positrons using the Pauli spinors in such a way that all the polarization features are retained. Several specific examples of the polarization features are discussed, and finally the annihilation equation is put into matrix form for use with the Stokes parameters. This later representation is particularly convenient in that it readily points out the general features of the annihilation process.

539.12

17312 LINEAR POLARIZATION OF THE ANNIHILATION RADIATION OF POSITRONS. H.Langhoff.
Z. Phys., Vol. 160, No. 2, 186-93 (1960). In German.

A new measurement of the relative linear polarization of this radiation is described. The angular resolution of the double-polarimeter used has been improved, in comparison with earlier experiments, by the construction of a fast fourfold-coincidence apparatus. Within an experimental error of 1.5% the results are in full agreement with the complete polarization predicted by pair theory.

539.12

17313 A SIMPLE METHOD FOR THE ENERGY ESTIMATION OF ELECTRON PAIRS. P.K.Aditya.
Indian J. Phys., Vol. 33, No. 8, 357-62 (Aug., 1959).

A simple and practical method is described by which electron pair energies from 2×10^7 eV to 10^{12} eV can be estimated with reliability. The initial divergence is modified by the multiple coulomb scattering of the electrons, and the energy of the primary photon derived from the observed opening, which is directly measurable. This method when applied to a considerable number of pairs obtained from electromagnetic cascades has been shown to yield meaningful results. The advantages and limitations of the method are discussed.

539.12

17314 PAIR PRODUCTION ON THE BASIS OF HOLE THEORY WITHOUT DIRAC MATRICES. B.N.Paria.
Indian J. theor. Phys., Vol. 6, No. 3, 69-76 (Sept., 1958).

The differential cross-section for the creation of an electron and positron pair by a γ-ray in the presence of a nucleus has been deduced taking Dirac's idea of "hole" but without using his matrices. This new method is a general one and can be applied successfully to all radiation problems.

539.12

17315 PRODUCTION OF LOW ENERGY ELECTRON PAIRS. J.Hück.
J. Phys. Radium, Vol. 20, No. 11, 917-18 (Nov., 1959). In French.

Derives an approximate formula for calculating the total cross-section for pair production. Comparison with calculations using the Heitler formula shows the approximate equation to be accurate to ~ 20%.
R.H.Thomas

539.12

17316 ANNIHILATION OF POLARIZED POSITRONS IN MAGNETIZED MATERIAL. I.Lovas.
Nuclear Phys., Vol. 17, No. 2, 279-88 (June (3), 1960).

The dependence of angular correlation of annihilation radiation on the polarization of negatrons and positrons was analysed and measured. The contribution of the bound negatrons to the annihilation process is about 5%.

5

17317 POSITRONIUM IN AN EXTERNAL FIELD. M.Kraev.
C.R. Acad. Bulg. Sci., Vol. 11, No. 6, 453-6 (Nov.-Dec., 1958). In Russian.

The anomalous magnetic moment to order α is shown to b
sum of the electron and positron magnetic moments, starting fr
Bethe—Salpeter equation.
D.W.L.S

Nucleons

5

17318 CONSIDERATIONS ON A MESON-ATOMIC MODEL THE NUCLEON. L.E.H.Trainor.
Canad. J. Phys., Vol. 38, No. 10, 1245-55 (Oct., 1960).

A model of the nucleon is described in which a π-meson m
about a nucleon core under the action of a hyper-Maxwell field.
such a model, the short range of the internucleon force appears
a screening effect. Despite its obvious limitations, the model d
possess some interesting features which lead to results in agre
ment with experiment. The advantage to such models is that th
may provide insight into problems which are enormously difficu
from the usual field theory point of view. In particular, one mi
hope to obtain some understanding of the state of the π-meson fi
in the nuclear many-body problem.

5

17319 ELECTROMAGNETIC STRUCTURE OF NUCLEONS K.Hiida, N.Nakanishi, Y.Nogami and M.Uehara.
Progr. theor. Phys., Vol. 21, No. 5, 762-3 (May, 1959).

Reports a calculation of the contribution to charge and mag
moment distributions from the three-pion state, in lowest order
R.J.N.Phi

539.12 : 5

PIONIC FORM FACTOR OF THE NUCLEON. See Abstr. 1

5

17320 NUCLEON—NUCLEON SPIN—ORBIT INTERACTIO AND THE REPULSIVE CORE. G.Breit.
Phys. Rev., Vol. 120, No. 1, 287-92 (Oct. 1, 1960).

Recent proposals to explain the phenomenological repulsive
core and spin—orbit interaction in nucleon—nucleon scattering
terms of a vector meson field are discussed. Estimates of the
mass of the vector meson made on the basis of the Bryan potent
may need some revision on account of insufficiently studied pos
bilities of modifying that potential. Estimates of interaction co
stants on the basis of the Signell—Zinn—Marshak potential and t
replacement of a two-body relativistic problem by a one-body p
lem do not appear applicable. Estimates based on a covariant
matrix element but neglecting wave-function distortion in the an
ysis of 300 MeV data are shown to be quite uncertain. Accordin
the evidence for a vector meson mass of $3m_\pi$ or $4m_\pi$ also appe
to have little weight. Masses $3m_\pi$ and $4m_\pi$ are shown to lead to
central-field potential energy tails which extend into the one-pi
exchange potential region and appear therefore to be improbabl
large. They also lead to repulsive cores which do not fit in wit
usual phenomenological hard cores as naturally larger heavy-p
masses. Brief mention is made of possible means of detecting
vector meson and of the effects of its finite mean life.

53

17321 DERIVATION OF THE TWO NUCLEON POTENTIAL A.Klein and B.H.McCormick.
Progr. theor. Phys., Vol. 20, No. 6, 876-89 (Dec., 1958).

A derivation of the two-nucleon potential is given which avo
the ambiguous features of the scattering formalism employed
previously (Abstr. 12865 of 1960). It is based on the reduction t
Schrödinger equation of a suitable covariant two-nucleon equatio
An approximate evaluation of the fourth-order potential emphasi
the significant departure of the present proposals from past
perturbation calculations, but represents a serious overestimate
quantitatively of the additional contributions.

5

17322 ELASTIC SCATTERING OF NUCLEONS AND PIONS VERY HIGH ENERGY.
Z.Koba, A.Krzywicki, R.Rączka and Z.Chyliński.
Nuovo Cimento, Vol. 15, No. 5, 843-6 (March 1, 1960).

Examines the approximations usually made to describe high

gy (several GeV) scattering of pions and nucleons. The condi-
s of applicability of the simple theories of the optical model
are considered. In particular, evidence for the existence of a
part of the optical potential, spin dependence in the nucleon–
eon collision, and the possible effect of a pion–pion resonance
discussed. No definite conclusions are drawn: the paper is in
ature of a progress report. J.D.Dowell

539.12

.7323

ELASTIC SCATTERING OF NUCLEONS AND PIONS AT VERY HIGH ENERGY.

oba, A.Krzywicki, R.Rączka and Z.Chyliński.
lear Phys., Vol. 19, No. 2, 199-220 (Oct. (1), 1960).

Theoretical considerations concerning the elastic scattering of
leons and pions in the GeV region are presented. Criteria for
validity of the simplest picture and a formula for constructing
optical potential from known phase shifts are given. The com-
ison with existing data reveals a sharp discrepancy in the case
–p scattering at 8.5 GeV (this was reported by Veksler, 9th
rnational Conference on High Energy Physics, Kiev, 1959).
ious possibilities to resolve this disagreement are discussed:
oduction of the real part of the phase shifts (for which the dis-
sion relations would give a direct check), spin-dependence of
lear interactions (which leads to predominance of the singlet
e interaction), and quasi-resonance. Some remarks are added
relevant topics.

539.12

17324

COLLISION OF NUCLEONS WITH LARGE ANGULAR MOMENTA.

.Galanin, A.F.Grahsin, B.L.Ioffe and I.Ya.Pomeranchuk.
lear Phys., Vol. 17, No. 2, 181-217 (June (3), 1960).

The part of the nucleon–nucleon scattering amplitude for large
ital angular momenta $l \gg 1$ which involves two-meson exchange
alculated in the present paper. The connection between this
plitude and the scattering of real mesons by nucleons is deter-
ed with the aid of dispersion relations. The method thus evolved
alid if the inequality $l\mu/p \gg 1$ holds (μ is the meson mass and p
nucleon momentum in the centre-of-mass system), apart from
condition $l \gg 1$. Specific calculations are performed for a sing-
amplitude in non-relativistic approximation for not very large
ital angular momenta $1 \ll l \ll 4m^2/\mu^2$ (m is the mass of a
leon and μ that of a meson). Calculations show that F- and G-
ses at nucleon energies in the laboratory system $E_l < \sim 150$ MeV
y be obtained from one-meson approximation with adequate accur-
. This conclusion may prove to be essential for the phase-shift
lysis of nucleon scattering.

539.12

17325

ON PERIPHERAL NUCLEON–NUCLEON INTERACTION IN THE TWO-MESON APPROXIMATION.

F.Grashin and I.Yu.Kobsarev.
clear Phys., Vol. 17, No. 2, 218-26 (June (3), 1960).

Triplet nucleon–nucleon scattering phase shifts for non-relativ-
ic energies are calculated in the two-meson approximation and
npared with the one-meson phase shifts. The one-meson approxi-
tion is found to be accurate for all mixing parameters (beginning
m $^3S-^3D$) and this permits one to use them in phase-shift analy-
for selection of a unique solution. The peripheral part of the
ective two-meson potential corresponding to the derived scatter-
amplitude is also found.

539.12

17326

POLARIZABILITY OF NUCLEONS.

A.M.Baldin.
clear Phys., Vol. 18, No. 2, 310-17 (Aug. (2), 1960).

Estimates of dipole polarizabilities of nucleons and the values
y involve are given on the basis of data on photo-production of
nesons and the Compton effect on nucleons. It is indicated that
upper estimate of neutron polarizability exists at present. The
eliminary experimental data now available may be interpreted as
licating that a neutron has an abnormally large polarizability.
e effects leading to the inapplicability of the impulse approxima-
n for describing the reaction $\gamma + d \to p + n + \gamma'$ are estimated. It
pointed out that the measurement of the cross-section of the
action $\gamma + d \to d + \gamma'$ would yield an answer for the value of
tron dipole polarizability.

539.12

17327

NUCLEON–ANTINUCLEON ANNIHILATION PRODUCTS.

S.C.Frautschi.
gr. theor. Phys., Vol. 22, No. 1, 15-24 (July, 1959).

Three models for nucleon–antinucleon annihilation are considered: the Fermi statistical model, the modification by Pomeranchuk which included strong $\pi - \pi$ interactions, and the Koba–Takeda model of fast "core" annihilation followed by slow emission of "cloud" pions. The parameters of the models are chosen to fit the experimental pion multiplicity $\langle n_\pi \rangle = 5.36$. It is shown that the Koba–Takeda model with a small core predicts quite different values than the other models for the average K-meson energy and pion multiplicity associated with $K\bar{K}$ events. Data on these quantities would distinguish between these models and provide indirect information on the $\pi - \pi$ interaction.

539.12

17328

NUCLEAR PROPERTIES OF ANTINUCLEONS.

E.Segré.
Science, Vol. 132, 9-13 (July 1, 1960).

Survey article based on 1959 Nobel Prize lecture.

539.12

17329

ABSORPTION EFFECTS IN ANTINUCLEON PHENOMENA. II.

Y.Kakudo, T.Kammuri and R.Nakasima.
Progr. theor. Phys., Vol. 20, No. 5, 779-81 (Nov., 1958).

For Pt I, see Abstr. 15343 of 1960. An attempt is made to remove the previous discrepancy between the experimental and theoretical cross-sections for antineutron production in nuclei by incident protons. A Fermi type distribution of nucleon density is used with parameters taken from electron scattering experiments. Considerably better agreement is obtained for carbon and lead. A.Ashmore

Protons

539.12

17330

PROTON HELICITY FROM Λ DECAY.

R.W.Birge and W.B.Fowler.
Phys. Rev. Letters, Vol. 5, No. 6, 254-7 (Sept. 15, 1960).

A measurement of the longitudinal polarization ($= -\alpha$) of the decay proton from unpolarized Λ is described. The result is $\alpha = -0.45 \pm 0.4$, which compares with the measurement by Boldt et al. of $\alpha = +0.85^{+0.15}_{-0.21}$. The present measurement together with the known magnitude of α suggest that α is negative, which would imply positive helicity for the proton. J.E.Paton

539.12

17331

NUCLEAR INTERACTIONS OF 5.7 BeV PROTONS IN PHOTOGRAPHIC EMULSION.

V.Y.Rajopadhye.
Phil. Mag. (Eighth Ser.), Vol. 5, 537-51 (June, 1960).

Tracks produced by 5.7 BeV protons in nuclear emulsions were followed till they interact with emulsion nuclei, and a mean free path of 35.6 ± 2.4 cm was obtained. About 24% of the shower tracks are found to be protons, all of which emerge at angles less than 20° with the direction of the primary. The mean multiplicity of pion production is found to be 2.6 ± 0.3, the coefficient of inelasticity 0.49 ± 0.07, and the transverse momentum of pions 220 ± 30 MeV/c. The angular distribution of the shower tracks was analysed on the assumption that the pions are produced in a single collision system with a forward–backward symmetry in the centre of mass reference frame. The mass of the particle with which the incident proton forms such a collision, is shown to have an upper limit of 1.08 ± 0.15 proton mass units. Hence the meson production on an average may be considered as arising in a nucleon–nucleon collision even with a complex target nucleus. The angular distribution of the pions in the C-system is found to be isotropic, within the limits of experimental errors.

539.12

17332

INVESTIGATION OF THE INTERACTION BETWEEN THE PRODUCTS OF REACTIONS IN WHICH SEVERAL PARTICLES ARE EMITTED.

V.V.Komarov and A.M.Popova.
Nuclear Phys., Vol. 18, No. 2, 296-302 (Aug. (2), 1960).

A method is presented for the investigation of the effect of the interaction between the products of reactions which involve the emission of several particles on the energy distribution of the latter. The spectra of neutrons emitted at angles of 0° and 180° in the c.m.s. in the $p + d \to p + p' + n$ reaction are computed for a total reaction energy of $\cong 4$ MeV, account being taken of pair interaction between nucleons in the final state. Some possible applications of the method are discussed.

539.12

17333 PHASE SHIFT ANALYSIS OF COMBINED COULOMB AND NUCLEAR SCATTERING. T.Tietz.

Acta phys. Hungar., Vol. 11, No. 3, 235-8 (1960).

An exact formula for the phase-shift of combined Coulomb and nuclear scattering is derived. The phase-shift can be calculated exactly if a sufficiently large zero of the solution of the Schrödinger equation containing the Coulomb and nuclear potential is known.

C.J.Batty

539.12

17334 ANGULAR DEPENDENCE OF POLARIZATION IN p—p SCATTERING AT 970 MeV. PRELIMINARY RESULTS.

R.J.Homer, G.W.Hutchinson, W.K.McFarlane, A.W.O'Dell, R.Rubinstein and E.J.Sacharidis.

Nuovo Cimento, Vol. 16, No. 6, 1132-4 (June 16, 1960).

The asymmetry in scattering a polarized proton beam from hydrogen was measured at eight angles from 25° to 85° centre of mass. While positive at large angles it falls off rapidly and apparently changes sign at about 25°. An appreciable spin—orbit splitting of the F phases would have led to negative polarization at large angles; the result suggests a change of sign in the proton—proton spin—orbit force which would minimize its effect on the F waves.

D.W.L.Sprung

539.12

17335 PROTON—PROTON EFFECTIVE—RANGE THEORY WITH VACUUM POLARIZATION. L.Heller.

Phys. Rev., Vol. 120, No. 2, 627-34 (Oct. 15, 1960).

The effect of vacuum polarization upon p—p scattering is considered by first solving the problem in the Coulomb plus vacuum polarization potentials (called "electric" potential) without the nuclear potential. The nuclear phase shifts are then defined with respect to the electric wave-functions, and the scattering cross-section is written in terms of these phase shifts. The connection with other nuclear phase shifts (in the presence of vacuum polarization) which appear in the literature is established. The effective-range expansion for the nuclear s-wave phase shift is derived. An analysis of three low-energy p—p scattering experiments indicates that the omission of vacuum polarization from the analysis results in a value for the shape-dependent parameter which is 0.02 smaller than the value obtained when vacuum polarization is included in the analysis. A discussion of the accuracy required to delimit this parameter usefully is included.

539.12

17336 P—P PHASE SHIFT SOLUTIONS AND DEPOLARIZATION SCATTERING PARAMETER AT 210 MeV.

K.Gotow and E.Heer.

Phys. Rev. Letters, Vol. 5, No. 3, 111-12 (Aug. 1, 1960).

Measurements of the scattering parameter $D(\theta)$ are reported. These eliminate two of the four empirical sets of phase shifts, found by MacGregor and Moravcsik (Abstr. 12931 of 1960) at this energy.

R.J.N.Phillips

539.12 : 539.1.07

17337 INTERNALLY REFLECTING ĊERENKOV COUNTER FOR HIGH ENERGY PROTONS.

N.E.Booth, F.L.Hereford and G.W.Hutchinson.

Nuclear Instrum., Vol. 3, No. 4, 229-32 (Oct., 1958).

A high energy proton detector is described, which utilizes multiple internal reflections of Cherenkov radiation to achieve a sharp energy threshold. The detector is capable of accepting a charged particle beam of cross-section comparable to that of the radiator. A preliminary version of the counter has been studied experimentally in the 500-900 MeV proton energy range. The performance of the detector agrees with that expected, when allowance is made for various factors which limit the resolution.

539.12

17338 ANTIPROTON—PROTON CROSS SECTIONS AT 1.0, 1.25 AND 2.0 BeV.

R.Armenteros, C.A.Coombes, B.Cork, G.R.Lambertson and W.A.Wenzel.

Phys. Rev., Vol. 119, No. 6, 2068-73 (Sept. 15, 1960).

The interaction of 1.0, 1.25, and 2.0 BeV antiprotons with protons was studied with the aid of a 4π solid-angle scintillation-counter detector system. The measured total cross-sections at the above energies are 100, 89, and 80 mb, respectively. At each energy, the charge-exchange cross-section is approximately 5 mb. The total elastic cross-sections are 33, 28, and 25 mb, respectively, at the three energies. The angular distribution of elastic scattering was fitted with a simple optical-model calculation.

53

17339 INFLUENCE OF BOSE—EINSTEIN STATISTICS ON ANTIPROTON—PROTON ANNIHILATION PROCESS.

G.Goldhaber, S.Goldhaber, W.Lee and A.Pais.

Phys. Rev., Vol. 120, No. 1, 300-12 (Oct. 1, 1960).

Recent observations of angular distributions of π-mesons in p̄—p annihilation indicate a deviation from the predictions of the usual Fermi statistical model. In order to shed light on these phenomena, a modification of the statistical model is studied. T assumption is retained that the transition rate into a given final state is proportional to the probability of finding N free π-meso in the reaction volume, but this probability is expressed in term of wave-functions symmetrized with respect to particles of like charge. The justification of this assumption is discussed. The model reproduces the experimental results qualitatively provide the radius of the interaction volume is between one-half and thre fourths of the pion Compton wavelength; the dependence of angul correlation effects on the value of the radius is rather sensitive. Qualitatively, there seems to remain some discrepancy, but it is impossible to say whether this is due to experimental uncertaint or to some other dynamic effects. In the absence of information π—π interactions and of a fully satisfactory explanation of the me pion multiplicity for annihilation, the authors wish to emphasize preliminary nature of these results. They are considered, howe as an indication that the symmetrization effects discussed may w play a major role in the analysis of angular distributions. It is pointed out that in this respect the energy dependence of the angu correlations may provide valuable clues for the validity of this model.

Neutrons

53

17340 ON THE HIGH ENERGY PROTON EJECTED IN THE HIGH ENERGY N—D COLLISION. Y.Sakamoto.

Progr. theor. Phys., Vol. 21, No. 5, 763-6 (May, 1959).

Calculates the cross-section and proton polarization at 90 M using given sets of n—p phase shifts and the impulse approximation. Because of the Pauli principle, the small-angle results are quite different from free n—p scattering.

R.J.N.Phil

53

17341 UPPER BOUND ON THE NEUTRON—DEUTERON DOUBLET SCATTERING LENGTH.

L.Spruch and L.Rosenberg.

Nuclear Phys., Vol. 17, No. 1, 30-43 (June (2), 1960).

The method of obtaining upper bounds on scattering lengths i applied to the determination of the n—d doublet scattering length A_D. A new calculation is unnecessary; an analysis of the trial function used by Efimov (Abstr. 3746 of 1959) in a variational estimate of A_D shows that the calculation effectively provided a bound. (The Efimov trial function has the "inappropriate" norma zation for present purposes, but it is exceedingly unlikely that th will alter the character of the present results. This question ca be readily resolved in any case.) It is found that the potentials assumed by Efimov imply $A_D < 1.1 \times 10^{-13}$ cm. If these potential are accurate (this question is still an open one), it follows that o the two experimentally allowed sets, namely $A_D = 0.7 \times 10^{-13}$ cm and $A_Q = 6.4 \times 10^{-13}$ cm (Set I), or $A_D = 8.3 \times 10^{-13}$ cm and $A_Q = 2.6 \times 10^{-13}$ cm (Set II), Set I is correct, a conclusion consis with some recent variational estimates of about 6×10^{-13} cm for quartet scattering length A_Q. It is also shown, for the general problem, that the exact numerically determined value of the "sta scattering length lies above the true value if the numbers of bou state solutions for the static and true problems are the same.

53

17342 ELASTIC SCATTERING IN HIGH ENERGY AND IMPULSE APPROXIMATION.

Y.Sakamoto and T.Sasakawa.

Progr. theor. Phys., Vol. 19, No. 6, 745-7 (June, 1958).

The angular distribution of neutron—deuteron elastic scatte at 90 MeV centre-of-mass is calculated using the Chew impulse approximation. The phase shifts due to Otsuki et al. and to Gam and Thaler are used to specify the elementary nucleon—nucleon interaction. Reasonable agreement with experiment is found for angles less than 110°.

J.S.Dow

539.12

7343 A NOTE ON POLARIZED CROSS SECTION OF HIGH ENERGY N—D ELASTIC SCATTERING. Y.Sakamoto.

r. theor. Phys., Vol. 21, No. 3, 459-60 (March, 1959).

Calculates $P(\theta)\sigma(\theta)$ at 90 MeV from two proposed sets of N—N e shifts, by means of the impulse approximation. Argues that considerations may help to fix these phase shifts.

R.J.N.Phillips

539.12

7344 NEUTRON THERMALIZATION: ASYMPTOTIC SPECTRUM AND DIFFUSION LENGTH IN A HEAVY WITH ARBITRARY ABSORPTION. J.Virkkunen.

. Acad. Sci. Fennicae A VI, No. 43, 27 pp.(1960).

The energy dependent diffusion equation has been derived from Boltzmann equation by means of the spherical harmonics method the heavy gas model. The neutron flux per unit energy and the mal diffusion length have been calculated by means of the Feen- perturbation formula supposing a source-free medium with stant scattering cross-section and arbitrary absorption. Numer- results refer to the case of 1/v-absorption. The method itself pplicable without these restrictions. Formulae are represented alculate the mean velocity, the mean inverse velocity and the an energy of the neutron spectrum as well as the neutron temp- ture. These results, which do not contain the 1/E-tail of the ctrum, are compared with the results reported in the literature. associate Laguerre polynomial $L_m^{(1)}(E)$ is represented with $m \leq 10$, and E with the values 0...(0,1)...3...(0,5)...10. Also e are tabulations of the integrals $B_{mn}^{(-1/2)} = \int_0^\infty L^{(1)}(E) \cdot E^{-1/2} \cdot$ $E L_n^{(1)}$ dE with $0 \leq m \leq 20$, $0 \leq n \leq 10$, and a tabulation of the grals $B^{(1/2)} = \int_0^\infty E^{1/2}\, Ee^{-E}\, L_n^{(1)}(E)\, dE$ with $n \leq 25$.

539.12

17345 THE HEAVY GAS MODEL IN DETERMINATION OF DIFFUSION COOLING COEFFICIENTS. J.Virkkunen.

. Acad. Sci. Fennicae A VI, No. 51, 13 pp. (1960).

The neutron thermalization near thermal energies can be culated approximately on the basis of the heavy gas model. In s model one disregards the effects of the chemical bonds and es the thermal motion of the moderator atoms into account in an roximate manner. The resulting equations are mathematically her simple and contain few physical constants. So these equations be applied easily in very common situations. The heavy gas del has been applied to the calculation of the energy dependent tron flux in a pulsed neutron experiment. The neutron flux is resented as a series in orthogonal functions. The space- endent eigenfunctions satisfy the equation $\nabla^2 y(\vec{r}) + B_k^2 y(\vec{r}) = 0$, and energy-dependent eigenfunctions are the associated Laguerre- ynomials of the order one multiplied by Ee^{-E}. E is the neutron rgy units of kT. The coefficients of the series expansions are culated from infinite groups of algebraic equations. These efficients of the series expansions are calculated from infinite ups of algebraic equations. These coefficients can be calculated merically on digital computers or iteratively also on a desk culator. The matrix elements in the equations are to be culated numerically with the exception of some simple cases. The ay constant of the fundamental space-mode is calculated. This stant can be brought into the form $\lambda = \lambda_a + DB^2 - CB^4$, where C the diffusion cooling coefficient. The formula for the diffusion ling coefficient is extracted from the series expansion. Numerical ues are calculated for the diffusion cooling coefficient in graphite, ryllium and heavy water. As regards to graphite and beryllium, agreement with measured values is good, within experimental rors. In the case of heavy water there is some ambiguity in the finition of the parameters of the heavy gas model. With suitably osen parameters the calculated and measured values can be ught into agreement.

539.12

17346 MEASUREMENT OF THE POLARIZATION OF D-D NEUTRONS BY A SOLENOID.

S.Dubbeldam, C.C.Jonker and F.J.Heemskerk.

clear Instrum. and Methods, Vol. 4, No. 4, 234-8 (May, 1959).

A solenoid is described which turns the polarization vector of D neutrons over +90° or −90°, while the detectors remain in a ed position. The method avoids the false asymmetries that may introduced if one turns the detectors over 180° and it allows vy shielding. This way good accuracy was obtained. For a thick, gold "drive-in" target the relative left-right asymmetry was found to be $|R_0| = (4.6 \pm 0.2)\%$ at $E_D = 450$ keV and $\theta_{1\,\mathrm{lab}} = 50^\circ$; $\theta_{2\,\mathrm{lab}} = 42^\circ$.

539.12

17347 A HIGH OUTPUT D—D NEUTRON GENERATOR FOR BIOLOGICAL RESEARCH.

A.C.van Dorsten and J.H.Spaa.

Nuclear Instrum., Vol. 1, No. 5, 259-67 (Sept., 1957).

A description is given of an appratus capable of producing a fast neutron flux exceeding 10^{10} neutrons per second from a D—D reaction. The set consists of a pressurized cascade generator and an accelerator tube with a rotary heavy ice target. The rectifiers used are of the selenium type.

539.12.

17348 MODIFICATION OF THE BROOKHAVEN FAST CHOPPER.

F.G.P.Seidl, H.Palevsky, D.J.Hughes and R.L.Zimmerman.

Nuclear Instrum., Vol. 1, No. 2, 92-3 (March, 1957).

This mechanical neutron shutter was designed to produce neutron bursts of 1 μsec length in the energy region from 1 eV to 10 keV. For these energies hydrogen is the best element for neutron attenuation, and consequently a high strength paper-based phenolic laminate was used to construct the defining slits of the chopper rotor. Important disadvantages of using hydrogen as the attenuator are that the neutron cross-section falls at higher energies, so the attenuation for unmoderated fission neutrons is weak, and that hydrogenous materials have a low stopping power for gamma rays. The latter is a serious problem because it limits the efficiency that one can obtain with the usual neutron detectors. In order to counteract the disadvantages, the Brookhaven fast chopper has been modified in such a way that six inches of steel are in the beam path when the rotor is in a closed position, by replacing the inner phenolic sections of the earlier design with steel.

539.12

17349 THE TIME-OF-FLIGHT TECHNIQUE APPLIED TO FAST NEUTRONS.

K.G.Malmfors, J.Kjellman and A.Nilsson.

Nuclear Instrum., Vol. 1, No. 4, 186-96 (July, 1957).

A system for the measurement of fast neutron velocities with the time-of-flight technique is described. The phase bunching of the extracted beam from a coventional cyclotron is used for the production of short bursts of neutrons. The integrated time-of-flight spectra are obtained by using a Tektronix 517 oscilloscope with a modified triggering device. The application of the system to a precision measurement of the mean energy of the accelerated protons is described.

539.12

17350 HIGH RESOLUTION NEUTRON TIME-OF-FLIGHT EXPERIMENTS USING THE HARWELL 15 MeV LINEAR ELECTRON ACCELERATOR.

F.W.K.Firk, G.W.Reid and J.F.Gallagher.

Nuclear Instrum., Vol. 3, No. 6, 309-15 (Dec., 1958).

A technique is described for producing neutron pulses of 0.25 μsec duration at 400 p.p.s. The electron gun of the Harwell 15 MeV linear accelerator is pulsed from an external modulator during the period of the normal radio frequency pulse of 2 μsec duration. Using timing channels of 0.2 μsec duration and a flight path of 31.8 m a nominal resolution of 8 $\mathrm{m}\mu\mathrm{sec\ m}^{-1}$ is obtained. The neutron output during the 0.25 μsec pulse is approximately 60% of the output obtained when using the normal 2 μsec electron pulse. Total cross-section measurements using a bismuth sample demonstrate the improved resolution in the energy region of 10 to 20 keV.

539.12

17351 A METHOD OF INCREASING THE TRANSMISSION OF A TIME-OF-FLIGHT SPECTROMETER FOR SLOW NEUTRONS. D.Cribier.

C.R. Acad. Sci. (Paris), Vol. 251, No. 2, 230-1 (July 11, 1960).

In French.

Shows how the counting rate for a pile neutron spectrometer may be, in certain circumstances, increased with no loss of resolution. Where one is interested in only a fraction of the spectrum of neutrons transmitted by a neutron chopper, the counting-rate may be increased by using a higher pulse repetition rate. The neutrons of required energy are selected by a mechanical shutter placed at a suitable position on the flight path.

R.H.Thomas

539.12

17352 AN APPLICATION OF MAGNETIC TAPE RECORDING TO NEUTRON TIME-OF-FLIGHT SPECTROSCOPY.

E.R.Rae and F.W.K.Firk.

Nuclear Instrum., Vol. 1, No. 4, 227-31 (July, 1957).

The technique of recording nuclear pulses on a twin-track magnetic tape has been applied to the examination of the prompt gamma rays following the capture of a slow neutron. The pulse-height spectrum produced by the gamma rays in a NaI crystal spectrometer is recorded on one track and a pulse denoting the time-of-flight of the neutron on the other. In this way the spectra of gamma rays due to capture of a neutron into a number of different resonances are recorded simultaneously and can be reproduced individually by selecting the gamma ray pulses corresponding to the appropriate group of timing pulses and playing them back into a multi-channel pulse-height analyser. The play-back time is a small fraction of the recording time so that the method, in addition to eliminating monitoring difficulties and providing a permanent record of the experiment, also leads to a considerable saving in time, both of the time-of-flight equipment and of the pulse-height analyser. The gamma rays due to neutron capture in Hg^{199} have been examined with this equipment and the results are discussed.

539.12 : 621.387.4 : 621.374.3

17353 CONSTRUCTION OF A CHRONOTRON FOR A FAST NEUTRON SPECTROMETER. J.Duclos.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960), p. 243-7. In French.

The source of neutrons is a tritium target, bombarded by deuterons from a 300 kV accelerator, giving rise to the simultaneous emission of a neutron, and an α particle. The instant of emission is determined by detecting the α particle. The coincidence circuit is an improvement of one due to O'Neill, in which the pulses are applied to two delay lines, between which are connected at regular intervals the two control grids of ten 6BN6 valves. The delay between the two pulses is determined approximately by the valve which produces the largest pulse. An interpolating circuit has been added in which the anodes of the valves are connected to points on a slow delay line. The current pulses charge the line in such a way that it carries an envelope pulse with a maximum at the point of coincidence. This maximum is detected at the end of the line and its time of arrival gives the delay between the two input pulses. For standard pulses, a time resolution less than 10^{-10} is claimed, but as the input pulse amplitude varies the distribution curve is shifted along the time axis. Nevertheless, for variations between 3 and 7V, the resolution is 2.2×10^{-9} sec. W.G.Stripp

539.12

17354 USE OF $Li^6I(Eu)$ AS A SCINTILLATION DETECTOR AND SPECTROMETER FOR FAST NEUTRONS.

R.B Murray

Nuclear Instrum., Vol. 2, No. 3, 237-48 (April, 1958).

The scintillation response of europium activated crystals of Li^6I to neutrons in the energy range 1-14 MeV has been investigated with the crystals maintained at various temperatures. The pulse-height spectrum from monoenergetic neutrons on a crystal at room temperature demonstrates a poorly defined and broad fast-neutron peak. Upon cooling the crystal, the fast-neutron peak becomes sharper and assumes a nearly Gaussian shape at temperatures below about −140°C. This behaviour is attributed to an increased scintillation efficiency of LiI(Eu) to alpha particles at low temperatures. Pulse-height spectra from crystals at the liquid nitrogen point are presented for neutrons from the $D(d,n)He^3$, $T(d,n)He^4$, and $Be^9(d,n)B^{10}$ reactions, a Po—Be source, and U^{235} fission. The principle features of $Li^6I(Eu)$ as a fast-neutron spectrometer are a relatively high detection efficiency ($\cong 0.1\%$) and moderate resolution.

539.12

17355 THE RESPONSE OF NaI(Tl) CRYSTAL TO MONOERGIC NEUTRONS. S.M.Shafroth, E.N.Strait and R.T.Carpenter.

Nuclear Instrum., Vol. 3, No. 5, 298-302 (Nov., 1958).

The response of a $1\frac{3}{4}$in. × 2 in. NaI(Tl) cylinder to neutrons in the pulse height region between 2.5 and 7 MeV gamma energy equivalent was studied as a function of incident neutron energy for a range of neutron energies between room scattered neutrons and 1.62 MeV. The $Li^7(p,n)Be^7$ reaction was used as a source of neutrons since it is relatively free from high-energy-gamma ray backgroud. Monoergic neutron response curves were obtained for neutron energies of 166 keV, 341 keV, and 469 keV. All other distributions were for proton energies giving rise to two neutron groups. The pulse height distributions were measured for a fixed number of counts of a shielded long counter at each neutron energy. The long counter was calibrated against Ilford C2 emulsions for the case of 1.162 and 0.698 MeV neutrons in order to obtain the neutron flux from long counter counts. The pulse height distributions are nearly linear between 4 and 6.6 MeV. The extrapolations of these distr butions intersect the gamma equivalent axis at approximately th binding energy of the last neutron in I^{128}.

5

17356 GRAPHITE SPHERE NEUTRON DETECTOR.

R.L.Macklin.

Nuclear Instrum., Vol. 1, No. 6, 335-9 (Dec., 1957).

A five foot graphite sphere has been constructed for neutron source intensity measurements, particularly for use in the kilov energy region. The measured efficiency using eight $B^{10}F_3$ detec near the surface is about 0.03 at 25 keV. The change in efficienc from 1 keV to 2 MeV is calculated to lie within ±1%. An absolut calibration of a (NBS) standardized Sb—Be neutron source was performed by measuring the exit current of thermal neutrons wi a thin wafer of $Li^6I(Eu)$ scintillator. The half life of Sb^{124} was al re-measured as 60.4 ± 0.2 days.

539.12 : 539.

17357 ALUMINIUM PROPORTIONAL COUNTER FOR THE MEASUREMENT OF LOW FAST NEUTRON FLUX.

R.N.Glover.

Nuclear Instrum., Vol. 3, No. 6, 316-19 (Dec., 1958).

A simple aluminium-walled proportional counter has been developed to measure low fast neutron flux by irradiation of the counter itself and subsequent counting of the β-rays from the 9.8 min Mg^{27} activity produced by the (n,p) reaction. The operationa characteristics are described and the sensitivity discussed. The counter is capable of detecting a fast neutron flux $\cong 10^3$ neutrons cm^{-2} sec^{-1}.

539.12 : 539.

17358 EFFICIENT DETECTOR FOR HIGH ENERGY NEUT

N.E.Booth and B.Ledley.

Nuclear Instrum., Vol. 1, No. 6, 345-50 (Dec., 1957).

A detector of neutrons in the energy range 400-900 MeV has been constructed and studied. At 800 MeV its efficiency is 1-2%. It consists of a rod of perspex 10 cm in diameter and 50 cm long one end of which is viewed by a photomultiplier. High energy incident neutrons are detected by observing the Cherenkov light emitted by charged secondary particles produced in the perspex. Since the average pulse height increases with incident neutron energy, the effective energy threshold may be raised by pulse he selection. Experimental results are presented for the dependenc of the efficiency upon the energy and direction of secondary protons. The neutron detection efficiency has been calculated as a function of energy.

539

17359 DOUBLE MODERATOR NEUTRON DOSIMETER.

J. de Pangher.

Nuclear Instrum. and Methods, Vol. 5, No. 2, 61-74 (Aug., 1959).

A moderated BF_3 detector was developed for measuring fast neutron dose, flux and average energy in the laboratory. It is be used for measuring dose in field conditions as well, in spite of its directional cylindrical geometry and its weight, because it is very sensitive to neutrons and quite insensitive to gamma radiation. This instrument, called the "double moderator" and consis of a "fluxmeter" and a "dosimeter", was calibrated with monoer neutrons from an accelerator and with neutrons from radioactive sources. Several applications are described.

539.12 : 621.387.

17360 ENRICHED BORON SCINTILLATORS FOR SLOW NEUTRONS. H.Durand and P.Habert.

Nuclear Electronics Conference, Paris, 1958. Vol. I, (see Abstr. 12719 of 1960), p. 45-52. In French.

Glass made of $B_4O_7H_2$ ($2B_2O_3,H_2O$) was mixed with a powder silver-activated zinc sulphate. Plain and crenellated Plexiglas supports were used. Measurements showed that efficiency was improved by a factor of 2 to 2.5 when the boron was enriched to B^{10}. The crenellated support gave a further improvement.

W.G.St

53

17361 MEASUREMENT OF NEUTRON FLUX AND SPECTR FOR PHYSICAL AND BIOLOGICAL APPLICATIONS.

Handb. Nat. Bur. Stand., No. 72, 92 pp. (1960).

The measurement of neutron flux and spectra is discussed,

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ous methods are compared, and results of intercomparisons given. Methods of measurement are discussed for the emission of radioactive neutron sources, thermal neutron flux, interiate neutron flux, fast neutron flux, and neutron energy spectra. tron radiation instruments for area survey and personnel itoring involving flux and spectrum measurements are included. ical spectra of various neutron sources are shown.

539.12

17362 SEARCH FOR ANTINEUTRON ANNIHILATION EVENTS IN NUCLEAR EMULSIONS.

i-Chü, M.Morand, G.Bourlet, C.Simonin and D.Schune.

vo Cimento, Vol. 17, No. 2, 259-62 (July 16, 1960).

Five antineutron annihilation events were found in a stack of emulsions exposed to the 740 MeV/c antiproton beam of the beva-. One of them is analysed in detail and the prongs identified as alitz pairs, 1 electron, 11 protons, 1 α-particle and 1 K^--meson.

A.Ashmore

sons

539.12

17363 EVIDENCE AGAINST THE EXISTENCE OF THE B^0 MESON.

omez, H.Burkhardt, M.Daybell, H.Ruderman, M.Sands and alman.

ys. Rev. Letters, Vol. 5, No. 4, 170-3 (Aug. 15, 1960).

An attempt was made to observe the reaction $\gamma + p \rightarrow B^0 + p$. .1 GeV bremsstrahlung beam was used. Protons of ± 12 MeV/c momentum, defined by a magnet, were counted in ncidence with photons, using a Cherenkov counter. An angle was sen so that most of the photon spectrum from the B^0 decay would above the maximum energy of the photons from the decay of π^0 sons produced in the corresponding reaction. An upper limit of ut 3×10^{-32} cm^2 was found for the B^0 production cross-section a corresponding lower limit to the B^0 lifetime of 10^{-18} sec. The thod is insensitive for a B^0 mass < 300 MeV but this is probably luded on other grounds.

A.Ashmore

539.12

17364 SYMMETRY BETWEEN MUON AND ELECTRON.

N.Cabbibo and R.Gatto.

ys. Rev. Letters, Vol. 5, No. 3, 114-16 (Aug. 1, 1960).

The Lagrangian for muons and electrons, in interaction through nimal coupling with the electromagnetic field, is written in a mmetric form. It is shown that it is impossible to incorporate ak interactions into a symmetric Lagrangian unless there are at st two neutrons. A quantity, "Muonic number", is shown to be nserved and it is this conservation law which forbids electrognetic transitions between muons and electrons.

E.J.Squires

539.12

17365 FORMATION OF MUONIUM AND OBSERVATION OF ITS LARMOR PRECESSION.

W.Hughes, D.W.McColm, K.Ziock and R.Prepost.

ys. Rev. Letters, Vol. 5, No. 2, 63-5 (July 15, 1960).

By detecting a component of the Larmor frequency of muonium $^+ - \bar{e}$) in the decay curve of polarized μ^+ brought to rest in argon 50 atm pressure, it was shown that a large proportion, close to 0%, of the muons form muonium before decaying.

S.J.Goldsack

539.12

17366 A METHOD FOR TRAPPING MUONS IN MAGNETIC FIELDS, AND ITS APPLICATION TO A REDETERMINA-ON OF THE E.D.M. OF THE MUON.

Charpak, L.M.Lederman, J.C.Sens and A.Zichichi.

ovo Cimento, Vol. 17, No. 3, 288-303 (Aug. 1, 1960).

A method for trapping muons in magnetic fields is described gether with its application to higher accuracy determination of the ectric dipole moment of the muon. The value found is: e.d.m. ≤ e $(5 \pm 5) \times 10^{-17}$ cm consistent with time reversal invariance.

539.12

17367 AN ANALYSIS OF THE CHARGED PARTICLES EMITTED FOLLOWING NEGATIVE MUON ABSORP-IONS IN PHOTOGRAPHIC EMULSIONS. C.Ishii.

ogr. theor. Phys., Vol. 21, No. 5, 663-75 (May, 1959).

Calculations are performed for the energy distribution of alpha rticles and protons following μ^- absorption in emulsion. Three apes, (a) the Chew—Goldberger distribution, (b) a Fermi gas at kT = 0 and (c) a Fermi gas at kT = 9 MeV, are assumed for the proton momentum distributions in the nucleus, and the μ^- absorption probability is calculated for the single particle process. Assuming that the total kinetic energy of the neutron produced is imparted to the compound nucleus, the author applies the statistical theory to emission processes. With assumption (c) for Ag and Br, the energy distributions of emitted alpha-particles are well explained by the calculations using the statistical theory, but the rate of proton emission derived is too small. If it is assumed that most of neutrons produced were directly emitted, assumption (a) may explain the energy spectrum of emitted particles. In assumption (b), the emission rate is too small. As for the absorption probability, all three shapes show reasonable agreement with experiment.

539.12

17368 VIRTUAL PION EFFECTS IN LONGITUDINAL POLARIZATION AND SPECTRUM OF NEUTRONS FROM UNPOLARIZED μ^- ABSORBED AT REST. A.Bietti.

Nuovo Cimento, Vol. 16, No. 6, 1151-4 (June 16, 1960).

The virtual pion effects are estimated using a Fermi-gas model for the nucleus, and are found to be quite small particularly at the high energy end of the spectrum. It is stressed that the spectrum and polarization are strongly dependent on the nuclear model which makes difficult detection of the virtual pion effects.

A.Ashmore

539.12

17369 A MEASUREMENT OF THE TOTAL ABSORPTION RATE OF MUONS IN CARBON. F.R.Stannard.

Nuovo Cimento, Vol. 17, No. 4, 599-606 (Aug. 16, 1960).

Negative muons stopped in a propane bubble-chamber form mesic atoms with carbon nuclei. Subsequently they either decay by their usual mode or interact with the nucleus. Based on a sample of 2519 mesons, the probability for interaction is found to be $(7.4 \pm 0.8)\%$, and the total absorption rate of muons in carbon becomes $(0.36 \pm 0.04) \times 10^5$ sec^{-1}. The result is found to be in satisfactory agreement with theory.

539.12

17370 PRECISE MEASUREMENTS OF THE MEAN LIVES OF μ^+ AND μ^- MESONS IN CARBON.

R.A.Reiter, T.A.Romanowski, R.B.Sutton and B.G.Chidley.

Phys. Rev. Letters, Vol. 5, No. 1, 22-3 (July 1, 1960).

The observed mean lives are 2.211 ± 0.003 μsec for μ^+ and 2.043 ± 0.003 μsec for μ^-.

S.J.Goldsack

539.12

17371 OBSERVATION OF THE "ISOTOPE EFFECT" IN THE NUCLEAR CAPTURE OF NEGATIVE MUONS BY CHLORINE.

W.J.Bertram, Jr, R.A.Reiter, T.A.Romanowski and R.B.Sutton.

Phys. Rev. Letters, Vol. 5, No. 2, 61-2 (July 15, 1960).

Muon capture rates measured in Cl^{37} and Cl^{35} were $(12.51 \pm 0.52) \times 10^5$ sec^{-1} and $(18.02 \pm 0.49) \times 10^5$ sec^{-1} respectively.

S.J.Goldsack

539.12

17372 VALIDITY OF Q.E.D. IN μ-PAIR PRODUCTION.

G.Furlan and G.Peressutti.

Nuovo Cimento, Vol. 16, No. 6, 1144-7 (June 16, 1960).

The production of μ pairs by colliding beam of electrons and positrons is discussed. A general form is taken for the interaction of the μ-meson with the electromagnetic field with electric and magnetic form factors. An expression is given for the differential cross-section and angular distribution plotted for different ratios of the magnetic and electric form factors. A significant extension of the limits of QED could be made for an energy of 200 MeV.

A.Ashmore

539.12

17373 SEARCH FOR A SECOND π^0.

W.Selove and M.Gettner.

Phys. Rev., Vol. 120, No. 2, 593-8 (Oct. 15, 1960).

The energy distribution of neutrons from the charge exchange reaction $\pi^- + p \rightarrow \pi^0 + n$ was studied, for π^- mesons stopped in liquid hydrogen, to investigate the possible existence of a second π^0 with mass within a few MeV of the mass of the "ordinary" π^0. No neutron group corresponding to such a second π^0 was seen. The sensitivity of the measurement was such that a second group of relative intensity above 10-20% would have been seen for any second π^0 with a mass in the range between about $\frac{1}{4}$ and 2 MeV away from the mass of the ordinary π^0. The data also give a lower limit to the π^0 lifetime: $\tau >\sim 5 \times 10^{-21}$.

539.12

17374 BRANCHING RATIO OF THE ELECTRONIC MODE OF POSITIVE PION DECAY.

H.L.Anderson, T.Fujii, R.H.Miller and L.Tau.
Phys. Rev., Vol. 119, No. 6, 2050-67 (Sept. 15, 1960).

A new measurement of the branching ratio

$$\frac{\pi^+ \to e^+ + \nu}{\pi^+ \to \mu^+ + \nu}$$

has been completed. A double-focusing magnetic spectrometer was used to observe the spectra of electrons emitted in π-decay and in μ-decay. The scintillation pulses from the pion and its decay electron were recorded on a travelling-wave oscilloscope. Timing and pulse-height measurements were used to distinguish good events from accidentals. The total number of $\pi - e$ events recorded in this experiment was 1346, of which 6% were accidentals and 5% were $\pi - \mu - e$ contamination. The branching ratio obtained from an analysis of the data over the $\pi - e$ and $\mu - e$ distributions and corrected to include all decay electrons was $(1.21 \pm 0.07) \times 10^{-4}$. This is close to the result expected for a universal V—A interaction. Kinoshita's calculation, taking into account radiative effects, gave 1.23×10^{-4}. These data also gave for the mean life of π decay $\tau_\pi = (25.6 \pm 0.8) \times 10^{-9}$ sec.

539.12 : 539.11

$\pi^0 \to 2\gamma$ DECAY: INVARIANCE UNDER T.C.P.

See Abstr. 17235

539.12

17375 PROPOSAL FOR MEASURING THE π^0 LIFETIME BY π^0 PRODUCTION IN ELECTRON—ELECTRON OR ELECTRON—POSITRON COLLISIONS. F.E.Low.

Phys. Rev., Vol. 120, No. 2, 582-3 (Oct. 15, 1960).

The cross-section for production of π^0 mesons by colliding electrons is calculated in the virtual photon approximation. This cross-section is directly proportional to the inverse π^0 lifetime, and the proportionality constant is independent of the strong couplings. For a centre-of-mass energy of 300 MeV and a π^0 mean life of 10^{-16} sec the total cross-section is about 10^{-33} cm^2.

539.12

17376 ON THE HIGH ENERGY BEHAVIOR IN FIELD THEORY. E.Kazes.

Nuovo Cimento, Vol. 16, No. 2, 368-9 (April 16, 1960).

It is shown that the $\pi \to N + \bar{N} + \pi$ vertex does not tend to the Born approximation value in the limit of infinite invariant momentum transfer. E.J.Squires

539.12

17377 PION—NUCLEON ATTRACTION AT SHORT DISTANCES. S.Doniach and E.Yamada.

Nuclear Phys., Vol. 18, No. 1, 14-22 (Aug. (1), 1960).

It is suggested that a theory which treats the π-meson as a strongly bound nucleon—antinucleon state could provide an explanation for the observed isobaric-spin dependence of the meson—nucleon s-wave scattering length. The consistency of this proposal is tested using a simple model.

539.12

17378 HIGH-ENERGY PION—NUCLEON COLLISIONS AND ISOTOPIC PROPERTIES OF THE PION—PION INTERACTION. A.Krzywicki.

Nuovo Cimento, Vol. 17, No. 3, 442-5 (Aug. 1, 1960).

An account of the results obtained for the high energy (E_π lab > > 4GeV) pion—nucleon interaction. Assuming a strong pion—pion interaction and considering only peripheral collisions, Dremin and Cerniavski's method is used in calculations. It is also assumed that the peripheral pion—nucleon collision is characterized by the scattering of the incident and virtual pions in a low relative angular momentum state and that the pion—pion scattering weakly depends on energy. A formula is quoted which gives the branching ratio, R for the reactions (1) $\pi^- + p \to \pi^0 + \pi^- + p$ (2) $\pi^- + p \to \pi^+ + \pi^- + n$ in terms of the experimental branching ratio R_{exp}. In the case of Walker's experiment at 4.5 GeV this gives R_{exp}/R not far from 4. R is also calculated in terms of the isotopic spin amplitudes of the $\pi - \pi$ system for seven extreme cases. A similar iso-spin analysis is considered for the process $\pi^- + p \to \pi^- + \pi^- + \pi^+ + p$ occurring in a bubble chamber. J.H.Gunn

53

17379 ON THE ABSORPTIVE RANGE IN THE PION—NUCL COLLISION AT HIGH ENERGIES. K.Ishida.

Progr. theor. Phys., Vol. 20, No. 5, 774-5 (Nov., 1958).

The production of an additional pion in a pion—nucleon collis is assumed to take place predominantly through a local pion—pio interaction. By assuming that there is only one pion in the pion field of the nucleus it is possible to calculate the effective radius the absorptive region of the nucleus due to this process. Results are given for 1.0, 1.4 and 2.0 BeV pion energy. The radius found too small to fit the diffraction peak in pion—nucleon elastic scatt ing. E.J.Squ

539

17380 ON THE ABSORPTIVE RANGE IN THE PION—NUCL COLLISION AT HIGH ENERGIES. K.Ishida.

Progr. theor. Phys., Vol. 21, No. 5, 676-80 (May, 1959).

The absorptive range in the pion—nucleon collision at high energies with an additional pion production is investigated on the standpoint of the $\pi - \pi$ interaction model. For this purpose, the "root mean square of the impact parameter" $(\bar{b}^2)^{1/2}$ is introduced and is calculated under the local $\pi - \pi$ interaction and some assun tions. $(\bar{b}^2)^{1/2}$ thus obtained is somewhat smaller than the experimentally inferred value.

539.

17381 ISOTOPIC SPIN DEPENDENCE OF THE PION—NUCLEON HIGHER RESONANCE. R.F.Peierls.

Phys. Rev. Letters, Vol. 5, No. 4, 166-7 (Aug. 15, 1960).

From the branching ratios for the various one-pion and two-pion channels produced in π—p collisions at 960 MeV it is inferr that there is strong interference between the $T = \frac{1}{2}$ and $T = \frac{3}{2}$ state It is shown that the results are consistent with a model dominated by final state interactions of a pion with the nucleon through the (3,3) state, and of two pions through the T = 1, J = 1 state.

R.F.Peier

539

17382 EXPERIMENTAL EVIDENCE FOR THE PION—PION INTERACTION AT 1 GeV. I.Derado.

Nuovo Cimento, Vol. 15, No. 5, 853-5 (March 1, 1960).

A low-energy peak in the energy spectrum of the recoil proto in the process $\pi^- + p \to p + \pi^- + \pi^0$ is interpreted as due to the production of the π^0 mesons through a direct pion—pion interactio

S.J.Golds

539

17383 CP INVARIANCE AND NON-LINEAR PION INTERACTIONS. V.Gupta and S.N.Biswas.

Nuovo Cimento, Vol. 16, No. 5, 971-2 (June 1, 1960).

It is shown that CP invariance and charge symmetry lead to parity-conserving interaction in the case of a nonlinear pion inte action with a fermion isotopic doublet. C.J.B

539.

17384 MESON—MESON INTERACTION. K.Igi and K.Kawarabayashi.

Progr. theor. Phys., Vol. 20, No. 4, 576-8 (Oct., 1958).

The effective pion—pion potential is calculated using perturb tion theory in the lowest order for a PS—PS meson theory. The potential is found to be repulsive in the isospin 2 state, attractive the isospin 1 state and possibly attractive in the isospin 0 state. Therefore both isospin 0 and isospin 1 states could contribute to the higher maximum in π^--p elastic scattering. J.S.Dowk

539.

17385 THE GLOBAL SYMMETRY OF PION—BARYON INTERACTIONS AND BOUND STATES OF HYPERON-NUCLEON SYSTEM. Y.Yamaguchi.

Progr. theor. Phys., Vol. 20, No. 1, 112-14 (July, 1958).

The hyperon—nucleon interaction is investigated assuming global symmetry and neglecting K-meson exchange. A hard core potential is used to enquire into the possibility of hyperon—nucleo bound states. Bound $\Sigma^- n$, $\Xi^0 p$ and $\Xi^- n$ states with small binding energies are found. J.S.Dowk

539

17386 APPLICATION OF DISPERSION RELATIONS TO MESON—NUCLEON SCATTERING. A.C.Finn.

Phys. Rev., Vol. 119, No. 5, 1786-1802 (Sept. 1, 1960).

Relativistic nonforward scattering dispersion relations are u otain information about low-energy meson—nucleon scattering. determined which of the s-, p-, and d-wave phase shifts are licted by dispersion theory. Charge independence is assumed. form of the dispersion relations used is justified by relating asymptotic energy dependence of the dispersion relation amplis to the assumption of a finite range of interaction and to the ce of a particular meson current and the usual equal time mutation relations. The relevance of the analytic properties ie scattering amplitude as a function of momentum transfer is ussed in connection with the partial wave expansion of the dision amplitudes. The contribution to the dispersion integrals n energies above the 33 resonance is estimated.

539.12

17387 SENSITIVITY OF LOW-ENERGY PION—NUCLEON SCATTERING TO A PION—PION RESONANCE.

.Frautschi.

s. Rev. Letters, Vol. 5, No. 4, 159-61 (Aug. 15, 1960).

It is argued that the T = 1, J = 1 pion—pion resonance, introed by Frazer and Fulco (Abstr. 7341 of 1960) predicts the wrong aviour for low-energy pion—nucleon scattering. In particular, J = $\frac{1}{2}$ P-states are strongly affected. The discrepancy with er predictions of this effect is discussed. R.F.Peierls

539.12

17388 A POSSIBLE EXPLANATION OF THE HIGH-ENERGY PEAKS IN PION—NUCLEON CROSS-SECTIONS.

Królikowski.

clear Phys., Vol. 17, No. 3, 468-76 (July (1), 1960).

The motion of the core inside the nucleon is pointed out as the sible origin of the high-energy maxima observed in pion—nucleon ttering. An effective range approach of the Chew—Low type ds to results which are not in contradiction with present experintal data.

539.12

17389 RECOIL IN PION—NUCLEON SCATTERING.

V.Gupta.

clear Phys., Vol. 18, No. 1, 85-90 (Aug. (1), 1960).

The object of this paper is to show the dependence of the n—nucleon scattering cross-section on nucleon recoil. To this the method of canonical transformations was used to obtain the ttering operator explicitly. Numerical results are given for + p → π^+ + p and the cross-section is found to decrease with rease of recoil. No attempt was made to fit results with experint as the calculation is in the lowest order perturbation theory.

539.12

17390 RESONANCE BEHAVIOUR OF SCATTERING AMPLITUDES IN DISPERSION RELATIONS.

J.W.Moffat.

clear Phys., Vol. 18, No. 1, 75-80 (Aug. (1), 1960).

A Breit—Wigner resonance behaviour of the total cross-section a model of pion—nucleon scattering is deduced from a relativistic persion relation and a physical energy spectrum. In virtue of the lyticity of the scattering amplitude in the cut plane of the energy expression is derived for the scattering amplitude which has the m of the solution to the Hilbert problem in the theory of singular egral equations. The scattering amplitude is therefore determined the behaviour of a phase angle θ. Points of discontinuity in θ rrespond to the location of resonances and lead to a Breit—Wigner mula for the total cross-section.

539.12

17391 ON THE ENERGY DEPENDENCE OF THE α_{33} PHASE-SHIFT.

G.Höhler.

ovo Cimento, Vol. 16, No. 3, 585-6 (May 1, 1960).

An empirical formula is quoted which fits the energy dependence the α_{33} phase-shift of π—p scattering for all measurements above 9 to 525 MeV. With this the author hopes to evaluate the principal lue integral above resonance and continue the investigation of the persion relation for the 3-3 amplitude. J.H.Gunn

539.12

17392 NEGATIVE PION—PROTON ELASTIC SCATTERING AT 600 TO 750 MeV.

J.I.Shonle.

ys. Rev. Letters, Vol. 5, No. 4, 156-9 (Aug. 15, 1960).

Results are given for the total cross-sections and angular disbutions for π^-—p scattering at 610, 655, and 750 MeV. The gular distributions, for cos $\theta \leq 0.9$, were fitted using a leastuares analysis by a power series up to $\cos^5\theta$. The results favour assignments of J = $\frac{3}{2}$ and J = $\frac{5}{2}$, with odd relative parity for the two higher resonances. Some background of other states is also required, however. R.F.Peierls

539.12

17393 MESON—MESON SCATTERING TERM AND LOW-ENERGY PION—NUCLEON SCATTERING.

M.Sugawara and A.Kanazawa.

Phys. Rev., Vol. 119, No. 6, 2074-6 (Sept. 15, 1960).

The modified Chew—Low integral equation for the pion—nucleon P-wave scattering amplitudes was derived by the present authors using the Chew—Low—Wick formalism and assuming a general static interaction Hamiltonian plus the meson—meson scattering term. Essentially the same result is shown to follow from dispersion relations in the no-nucleon-recoil approximation if one assumes that the almost-forward elastic scattering amplitude becomes a finite real number at large incident pion energy. If one further presumes that the extra term to be introduced into the Chew—Low integral equation is just the zero-energy limit of the corresponding term, which was energy dependent in the previous derivation. The modified effective-range expansion of the P-wave phase shift is compared with the data. The S-wave integral equations are also given; they are formally much simpler than those obtained previously in the static model calculation.

539.12

17394 EVIDENCE FOR TWO PION—PION RESONANCES.

F.Selleri.

Nuovo Cimento, Vol. 16, No. 4, 775-9 (May 16, 1960).

A careful analysis of the existing experimental information on the inelastic part of high energy $\pi^\pm$—p scattering suggests the existence of two pion—pion resonances in the isotopic spin states I = 1 and I = 2. The author claims that the only explanation of the 0.9 GeV maximum in σ^- which does not contradict experiment is in terms of a strong pion—pion interaction in the I = 1 state in agreement with the theoretical ideas of Chew and Mandelstam. That only π—π interaction contributes to pion production is shown not to contradict the fact that the 3—3 isobar model seems to explain the experimental facts. It is shown that the idea that an inelastic channel for π^-—p scattering goes mainly through the diagram corresponding to an incoming meson hitting a meson of the cloud and shaking it off without further interaction followed by a possible final state interaction is in qualitative agreement with experimental data whilst other possibilities are not. Noting the striking similarity between this maximum and the one in σ^+ at 1.3 GeV, the author deduces than an I = 2 π—π resonance should exist. J.H.Gunn

539.12

17395 THE EFFECT OF MULTIPLE SCATTERING IN THE PHOTOPRODUCTION OF CHARGED MESONS AT DEUTERIUM.

N.MacDonald.

Nuovo Cimento, Vol. 15, No. 2, 301-3 (Jan. 16, 1960).

An impulse approximation calculation taking meson—nucleon multiple scattering into account is outlined. An approximation is discussed which necessitates knowing the pion—nucleon scattering amplitude only on the energy shell. The multiple scattering correction is found to be −5% at the low-energy pion peak and −20% at the higher peak, which is due to the final state nucleon—nucleon interaction. A photon energy of 300 MeV is employed.

J.S.Dowker

539.12

17396 ON THE CONNECTION BETWEEN SCATTERING AND PHOTOPRODUCTION OF PIONS AT HIGH ENERGIES.

C.Pellegrini and L.Tau.

Nuovo Cimento, Vol. 16, No. 5, 973-5 (June 1, 1960).

The relation which follows from unitarity and time reversal invariance existing between the elements of the S-matrix for scattering and photoproduction of pions on nucleons is generalised to include effects of double pion production assuming the isobar model of Lindenbaum and Sternheimer. J.H.Gunn

539.12

17397 REMARKS ON NEUTRAL PION PHOTOPRODUCTION IN THE HIGH ENERGY REGION.

C.Pellegrini and G.Stoppini.

Nuovo Cimento, Vol. 17, No. 2, 269-73 (July 16, 1960).

It is shown how the sign of the polarization of the recoil proton in the reaction $\gamma + p \rightarrow \pi^0 + p$ can be deduced for the models of Wilson (Abstr. 7245 of 1958), and Peierls (Abstr. 1676 of 1959). Use is made of the sign of the interference term in the differential cross-section, which changes from positive to negative between the first two resonances. The observed negative sign of the polarization is given only by the Peierls model with the second resonance E1 absorption to a state of negative parity. A.Ashmore

539.12

17398 FORWARD ANGLE PHOTOPRODUCTION OF SINGLE POSITIVE PIONS ON HYDROGEN.

M.Beneventano, G.Finocchiaro, R.Finzi, L.Mezzetti, L.Paoluzzi and C.Schaerf.
Nuovo Cimento, Vol. 17, No. 2, 274-8 (July 16, 1960).

Preliminary results are reported on measurements of the differential cross-section between 10^0 and 90^0 c.m. at incident photon energies of 600, 700, 800 and 900 MeV. At 20^0 and 90^0 the energy dependence of the cross-section was investigated. A magnetic spectrometer was used to define the pion and hence the photon energy, and gave an energy resolution increasing from ±18 MeV at 600 MeV to ±35 MeV at 900 MeV. Angular distributions are plotted for the four energies and energy distributions for the two angles. A.Ashmore

539.12

17399 PHOTOPRODUCTION OF NEGATIVE MESONS IN DEUTERIUM.

D.H.White, R.M.Schectman and B.M.Chasan.
Phys. Rev., Vol. 120, No. 2, 614-21 (Oct. 15, 1960).

A 24 in. diffusion cloud chamber filled to 14 atm with tritium-free deuterium gas, operating in a magnetic field of 6 kG, was placed in the 1040 MeV "hardened" bremsstrahlung beam of the Cornell synchrotron. A total of 310 events of the type $\gamma + d \rightarrow p + p + \pi^-$ was observed and analysed. Using the "spectator model", a total cross-section was determined for the reaction $\gamma + n \rightarrow p + \pi^-$ from threshold to 1 BeV, in good agreement with the results obtained from the measurement of the negative-to-positive pion ratio together with the measured cross-section for the reaction $\gamma + p \rightarrow n + \pi^+$. The momentum distribution of the low-energy protons in the laboratory system compares very favourably with the internal momentum distribution of the deuteron as calculated from the Hulthen or Gartenhaus wave-functions. The validity of the spectator model for photons above 200 MeV is experimentally justified, as is expected in consideration of the assumptions of the impulse approximation. A study of the forward—backward asymmetry of the spectator protons in the laboratory system indicates that above photon energies of 250 MeV, there is a 15% deviation from isotropy, favouring the forward beam direction, indicating that the spectator proton is being "pulled along" with the net forward momentum of the rest of the system, through an average forward momentum transfer of about 10 MeV/c.

539.12

17400 EFFECTIVE-RANGE FORMULA FOR PHOTOPRODUCTION FROM PIONS.

How-Sen Wong.
Phys. Rev. Letters, Vol. 5, No. 2, 70-2 (July 15, 1960).

A simple and reasonably accurate formula is derived for the $\gamma + \pi \rightarrow 2\pi$ amplitude which can be used in the Chew—Mandelstam approach to the strong-interaction problem at low energies in any phenomenon involving photons. Using the Mandelstam representation and the Omnes—Frazer—Fulco method the singularities of the partial wave amplitudes are located. It is found that an arbitrary constant Λ must be introduced which cannot yet be related to fundamental constants but which is determined by considering the decay of neutral pions, assuming that the $\gamma + \pi \rightarrow 2\pi$ reaction plays a prominent role in the intermediate state; a value of 1.3 e is given for $|\Lambda|$. Both "one-pole" and "two-pole" formulae are given. J.H.Gunn

539.12

17401 EFFECT OF THE PION—PION RESONANCE ON THE NEGATIVE—POSITIVE RATIO.

J.S.Ball.
Phys. Rev. Letters, Vol. 5, No. 2, 73-4 (July 15, 1960).

An expression is derived for the negative—positive ratio at threshold which depends upon the parameter Λ introduced by Wong (see preceding abstract). Using Wong's estimate of the size of $|\Lambda| \cong e$ it is shown that the ratio R = 1.16 or 1.44 depending on the sign of Λ. J.H.Gunn

539.12

17402 ELECTROPRODUCTION OF PIONS FROM HYDROGEN AND DEUTERIUM.

G.G.Ohlsen.
Phys. Rev., Vol. 120, No. 2, 584-92 (Oct. 15, 1960).

The absolute cross-section for direct production of pions in electron—proton and in electron—deuteron collisions was measured by the detection of inelastically scattered electrons. Proton data were taken throughout the range of $q^2 = 2.6\ f^{-2}$ to $q^2 = 10.75\ f^{-2}$,
centre-of-mass energy E = 1100 MeV to E = 1300 MeV. Data ana
ysis was in terms of a neutron magnetic moment distribution. C
parison with available theory yields a neutron r.m.s. magnetic
moment of 1 f, but better theoretical calculations may change thi
value somewhat. No theory for the electroproduction of pions fr
deuterons exists at present. The deuteron data are presented in
terms of absolute cross-sections as well as in terms of a deuter
proton cross-section ratio.

53

17403 EXTENSION OF THE ISOBARIC NUCLEON MODEL PION PRODUCTION IN PION—NUCLEON AND NUCLEON—NUCLEON COLLISIONS.

S.J.Lindenbaum and R.M.Sternheimer.
Phys. Rev. Letters, Vol. 5, No. 1, 24-6 (July 1, 1960).

The two higher resonances in the $T = \frac{1}{2}$ cross-section of the
π—N system which occurs at 600 and 880 MeV incident pion ene
are assumed to be due to higher isobaric states of the nucleon w
have two different decay modes. The momentum spectra of the
π^0 and π^- mesons from the reactions $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ and
$\pi^- + p \rightarrow \pi^- + \pi^0 + p$ have been obtained together with the branchi
ratios for the various pion-producing reactions for the p—p and
n—p collisions. For pion production in nucleon—antinucleon inte
actions without annhilation, it is assumed that the reaction may
proceed via the formation and decay of an anti-isobar, and the c
sections are calculated accordingly. J.H.C

53

17404 PION PRODUCTION FROM π^-—p COLLISIONS IN T LONG-RANGE INTERACTION MODEL.

F.Salzman and G.Salzman.
Phys. Rev., Vol. 120, No. 2, 599-608 (Oct. 15, 1960).

Long-range interactions of negative pions with protons resul
ting in single and double pion production are examined in terms
meson field theory model in which it is assumed that there is a
pion—pion interaction and that the single virtual pion exchange
graphs are dominant in large-impact-parameter collisions. Thi
pion exchange leads, in single pion production, to an "excited sta
π^*, which "decays" into two pions, and, in double pion production
also to an "excited state", N^*, which "decays" into a pion and a
nucleon. For sufficiently high relative energy of the incident π^-
proton, each of these processes can occur for small values of th
invariant square of the virtual pion four-momentum, Δ^2, in which
case the virtual pion carries very little transverse three-momen
tum. For small Δ^2 it is shown that it is reasonable to neglect fin
state interactions between the "decay products" of the π^* and tho
of the N^*. It is found that in the limit $\Delta^2 \rightarrow -\mu^2$, where μ is the p
rest mass, the virtual pion behaves kinematically, in the π^* bary
centric system, as an incoming pion which scatters elastically w
the incident π^-, and also behaves, in the N^* barycentric system,
an incoming pion which scatters elastically with the incident prot
Thus, for small Δ^2 in the physical region the π^* and N^* vertices
defined as the corresponding off-the-mass-shell scattering ampli
tudes. A ratio of appropriately defined double-to-single pion pro
duction cross-sections is obtained which is independent of the
details of the assumed pion—pion interaction, and depends only o
the relative strengths of N^* and N formation. This ratio is esti
mated by means of the p-wave static nucleon model, applied in
appropriate coordinate systems. For incident 5 BeV/c pions this
model leads to double pion production which is important compar
to single pion production, both because of the $\frac{3}{2}$—$\frac{3}{2}$ pion—nucleon r
sonance and because of important phase-space factors. Kinemati
considerations similar to those described above suggest that this
model may also be the theoretical genesis of the "two fireballs"
model proposed for ultrarelativistic nucleon—nucleon collisions.

539

17405 SINGLE PION PRODUCTION IN 0.96 GeV π^-—p INTE ACTIONS.

E.Pickup, F.Ayer and E.O.Salant.
Phys. Rev. Letters, Vol. 5, No. 4, 161-3 (Aug. 15, 1960).

From hydrogen bubble-chamber photographs an analysis was
made of 415 events of the reaction: $\pi^- + p \rightarrow n + \pi^+ + \pi^-$, and 267
events of the reaction: $\pi^- + p \rightarrow p + \pi^0 + \pi^-$. By plotting Q value
evidence for resonances in the N—π and π—π systems was sought
Evidence was found for the (3,3) resonance in the ($p\pi^0$) and ($n\pi^-$)
tems, and of the (1,3) resonance in the ($p\pi^-$) and ($n\pi^+$) systems.
There was also a peak at a Q value of 325 MeV for the ($\pi^-\pi^0$) sys
tem with backward protons. A.Ashm

539.12

17406 FIELD THEORETICAL INTERPRETATION OF MULTIPLE MESON PRODUCTION.

mamura and K.Kobayakawa.
ogr. theor. Phys., Vol. 21, No. 3, 477-8 (March, 1959).

Gives a method for calculating cross-sections, subject to various sumptions. R.J.N.Phillips

539.12

17407 OBSERVATION OF $\pi-\pi$ RESONANCE IN PION PRODUCTION. S.D.Drell and F.Zachariasen.

ıys. Rev. Letters, Vol. 5, No. 2, 66-8 (July 15, 1960).

A procedure is suggested for testing whether the resonance in e $J = 1$, $T = 1$ state of the $\pi-\pi$ system exists; this procedure is mpared to that of Goebel, Chew and Low. The two reactions (1) $+ N \rightarrow \pi + \pi + N$ and (2) $\pi + N \rightarrow \pi + \pi + N$ are compared and an tempt is made to identify a resonance in the final-state inter-tions of the two out-going pions. By a suitable choice of the kine-atics the authors greatly reduce the effect of the $\pi-N$ interaction, that any variations in the cross-sections for (1) and (2) are esumably due to variation in the $\pi-\pi$ interaction. A crude esti-ate is made of the effect of a $\pi-\pi$ resonance on the photoproduc-on process (1) by grafting part of the effect of the resonance onto e $\gamma + N \rightarrow \pi + \pi + N$ amplitude as calculated in the static model. lthough crude this shows that there are no unexpected factors which nd to damp out the effect of the $\pi-\pi$ resonance. J.H.Gunn

539.12

17408 REMARK ON THE τ^+ MESON DECAY.

W.Alles.
uovo Cimento, Vol. 16, No. 6, 1148-50 (June 16, 1960).

The author argues that deviations of experimental energy pectra from the predictions of Dalitz may be explained by the resence of $\pi^+\pi^-$ P-waves in the decay amplitude, without appealing a strong S-wave $\pi\pi$ final state interaction. R.J.N.Phillips

539.12

17409 SOME REMARKS ABOUT THE SPECTRAL REPRESENTATION OF THE $K^\pm \rightarrow 3\pi$ DECAY AMPLITUDE.

Fubini and R.Stroffolini.
uovo Cimento, Vol. 17, No. 2, 263-6 (July 16, 1960).

A representation for the $K^\pm \rightarrow 3\pi$ decay amplitude is proposed, ıd it is shown how this can be obtained by extending, in the K mass, approximate form of the Mandelstam representation for the ıphysical $K + \pi \rightarrow \pi + \pi$ scattering process. The spectral function complex, and it is shown how its imaginary part can be related to cattering processes in which all three pions take part.
E.J.Squires

539.12

17410 THE MEASUREMENT OF THE K_1-K_2 MASS DIFFERENCE. W.S.C.Williams.

uclear Phys., Vol. 18, No. 1, 173-5 (Aug. (1), 1960).

This note proposes the principle of a method of measuring the ıass difference of the K_1 and K_2 neutral mesons.

539.12

17411 K-MESON PARITY FROM DISPERSION RELATIONS.

F.Selleri.
Nuovo Cimento, Vol. 15, No. 6, 986-90 (March 16, 1960).

This problem is discussed using the effective range expansion f the K^+-p scattering amplitude. The results suggest a pseudo-calar K, with respect to at least one of the hyperons, and it is elieved that the uncertainty could be removed by knowledge of the ow-energy behaviour of the K^+-p total cross-section.
E.J.Squires

539.12

17412 A NOTE ON THE RELATIVE PARITY $p_{K\Sigma}$.

A.P.Balachandran and N.R.Ranganathan.
Nuovo Cimento, Vol. 16, No. 6, 1142-3 (June 16, 1960).

Two suggestions are made for determining the relative parity $_{KY}$. The first is to detect the polarization of the Λ^0 (from the symmetry of its decay products) from the decay of Σ^0 produced in he bombardment of a transversely polarized proton target by $^-$-mesons. The second is similar except that the bombarding articles are K^- mesons, the Σ^0 being produced by the reaction $^- + p \rightarrow \Sigma^0 + \gamma$. A.Ashmore

539.12

17413 INTERACTIONS OF K^--MESONS AT REST IN NUCLEAR EMULSIONS. V. THE MULTI-NUCLEON CAPTURE MODE.

M.Nikolič, Y.Eisenberg, W.Koch, M.Schneeberger and H.Winzeler.
Helv. phys. Acta, Vol. 33, No. 3, 221-36 (1960).

For Pt IV see Abstr. 6041 of 1959. From a complete study of about 1100 K^- absorptions at rest in nuclear emulsions, it was determined that the multinucleon capture mode forms 37% ± 5%. The energy spectra of the Σ-hyperons were measured and calculated and a separation between Σ-hyperons resulting from single nucleon and multinucleon K^--captures was performed. Some evidence of the fact that multinucleon captures take place mostly in the heavy emulsion nuclei is presented. A method of determining all the multinucleon reaction rates is suggested and applied to data obtained. This method makes use of the number and spectra of fast protons emitted from the K^--capture stars obtained in the present work. The results are compared with the predictions of a model recently proposed.

539.12

17414 INTERACTIONS OF K^--MESONS AT REST IN NUCLEAR EMULSIONS. VI. THE SINGLE NUCLEON CAPTURE MODE.

W.Koch, Y.Eisenberg, M.Nikolic, M.Schneeberger and H.Winzeler.
Helv. phys. Acta, Vol. 33, No. 3, 237-54 (1960).

From an analysis of the pion producing events in K^- captures at rest in nuclear emulsions, the features of the single nucleon K^- capture mode were studied. Using the pion and Σ-hyperon emission probabilities obtained in the present experiment, and assuming charge independence, all the single nucleon (1N) reaction rates could be determined. Comparing this data with other K^-absorption experiments, the energy dependence of the 1N matrix elements becomes evident. It is estimated that 63% ± 5% of K^- captures lead to a 1N reaction and the rest give rise to multi-nucleon reactions. A study of electrons associated with the K^- capture stars indicates that a large fraction of the 1N captures take place in the light emulsion nuclei and that most of the multi-nucleon captures take place in the heavy nuclei. It is shown that the Σ (or π) charge exchange scattering is small, in contrast to a large Σ-interactions ($\Sigma \rightarrow \Lambda$) cross-section.

539.12

17415 INTERACTION BETWEEN A PAIR OF K^+ MESONS.

S.Barshay.
Phys. Rev., Vol. 120, No. 1, 267-9 (Oct. 1, 1960).

An analysis is performed for the reaction $\Xi^+ + p \rightarrow K^+ + K^+ + \gamma$, with subsequent materialization of the photon into an electron-positron pair. In the circumstance that (a) the annihilation of low-energy Ξ^+ proceeds largely via the reaction $\Xi^+ + p \rightarrow K^+ + K^+$ and that (b) the elastic scattering on the Ξ^+ on hydrogen is largely a diffraction effect, a study of the radiative reaction provides, in principle, a means of determining a function related to the phase shifts for the scattering pair of K^+-mesons. Under assumption (b) alone, an absence of all meson-meson interactions among pions and K-mesons could be inferred from the vanishing of a certain angular correlation term in the radiative process. See also Abstr. 17423 of 1960.

539.12

17416 SEARCH FOR EVIDENCE OF PARITY NONCONSERVATION IN K—He INTERACTIONS. M.M.Block,

E.B.Brucker, R.Gessaroli, T.Kikuchi, C.M.Meltzer, A.Pevsner, P.Schlein, R.Strand, H.O.Cohn, E.M.Harth, J.Leitner, A.Minguzzi-Ranzi, L.Monari and G.Puppi.
Phys. Rev., Vol. 120, No. 2, 570-1 (Oct. 15, 1960).

Parity conservation in strong strange-particle producing interactions is not yet experimentally settled. In a search for evidence of parity nonconservation in K—He interactions, the expectation value of the pseudoscalar $\vec{P}_\Lambda \cdot \vec{\sigma}_\Lambda$ was measured. This quantity is directly obtained from the decay-pion angular distribution in the Λ rest frame. The observed angular distribution is symmetric. An analysis of 485 Λ^0 producing interactions gives $\alpha \langle \vec{P}_\Lambda \cdot \vec{\sigma}_\Lambda \rangle = +0.04 \pm 0.08$. Thus, no evidence was found for parity nonconservation in $K-He^4$ reactions.

539.12

17417 T = 0 K^+—NUCLEON PHASE SHIFTS BASED ON THE OPTICAL MODEL.

M.A.Melkanoff, D.J.Prowse, D.H.Stork and H.K.Ticho.
Phys. Rev. Letters, Vol. 5, No. 3, 108-11 (Aug. 1, 1960).

S and P wave T = 0 phase-shifts are inferred from optical model fits to K^+—nucleus scattering data at 125 and 260 MeV. Two solutions are found. They disagree with the results of Rodberg and Thaler (Abstr. 11224 of 1960), who however used a square-well rather than a diffuse-surface optical potential. R.J.N.Phillips

539.12

17418

DETERMINATION OF K^+—n, P-WAVE PHASE SHIFTS FROM K^+—d REACTIONS.

T.B.Day, L.S.Rodberg, G.A.Snow and J.Sucher.
Nuovo Cimento, Vol. 16, No. 4, 770-4 (May 16, 1960).

The differential cross-section for K^+—deuteron scattering is evaluated for both charge exchange and non-charge exchange processes at an incident momentum of 520 MeV/c for various P-wave, T = 0 phase-shifts. The scattering is found to be sensitive to both the magnitude and sign of the P-wave phase-shifts. C.J.Batty

539.12

17419

NON-ADIABATIC TREATMENT OF THE SCATTERING OF K^+ MESONS BY NUCLEONS.

G.Białkowski and A.Jurewicz.
Nuclear Phys., Vol. 17, No. 3, 359-76 (July (1), 1960).

Assuming pseudoscalar Yukawa coupling between K-mesons and baryons, the K^+—nucleon phase shifts were calculated. The method used is the three-dimensional Tamm—Dancoff approximation Calculations were performed for the $S_{1/2}$, $P_{1/2}$ and $P_{3/2}$ waves in the T = 1 and T = 0 states. The corresponding phase shifts and the total cross-sections for K^+ on p and K^+ on n, elastic and charge-exchange scattering are presented. The only parameters to be determined from experimental data are the coupling constants G^2 and $\mathcal{G}^2$. A discussion of the values of these quantities is given.

Hyperons

539.12

17420

STRONG INTERACTIONS AND A MODEL FOR HYPERONS. I.Goldberg and L.F.Landovitz.

Phys. Rev., Vol. 119, No. 6, 2077-81 (Sept. 15, 1960).

Using a 4-dimensional approach, the couplings of the strongly interacting particles are restricted in a simple way which is not inconsistent with experiment. This leads to the consideration of a Goldhaber-type model. The gross properties of the hyperons are calculated in the intermediate-coupling approximation for this model.

539.12

17421

ON THE PHOTONIC DECAY OF THE HYPERONS. L.Tenaglia.

Nuovo Cimento, Vol. 17, No. 3, 423-8 (Aug. 1, 1960).

The matrix element for the photonic decay of the hyperons is evaluated: it is given as a function of the matrix element for the pion-photoproduction by nucleons. The results obtained (namely, the branching ratio between photonic and pionic decay of the hyperons) agree with the few experimental data known at present.

539.12

17422

ON THE INTERACTION HAMILTONIAN FOR THE DECAY OF Σ-HYPERONS. S.Hori.

Nuclear Phys., Vol. 17, No. 2, 227-37 (June (3), 1960).

The interaction Hamiltonian for the decay of Σ-hyperons is phenomenologically constructed under the assumptions that: (1) the spin of the Σ-hyperon is ½, (2) the CP-invariance holds, (3) the effects of the final state interactions are negligible, (4) $\tau(\Sigma_-) = 2\tau(\Sigma_+)$, (5) the branching ratio is $w(\Sigma_+ \rightarrow p + \pi_0)/w(\Sigma_+ \rightarrow n + \pi_+) = 1$, (6) the $\Delta I = \frac{1}{2}$ rule is valid, (7) $\alpha_+ = \alpha_- = 0$. These assumptions are sufficient to determine the interaction Hamiltonian uniquely if the coupling type (derivative or direct) of the Hamiltonian is prescribed, and from the Hamiltonian the result $\alpha_0 = \pm 1$ is obtained, which is not inconsistent with the experiment. Conversely, when the assumption (6) is replaced by $\alpha_0 = \pm 1$, one cannot conclude that the $\Delta I = \frac{1}{2}$ rule holds. If one assumes $\alpha_0 = \pm 1$, $\alpha_+ = 0$, and leaves α_- arbitrary, taking into account the fact that the polarization of the Σ_--hyperon may be small, two kinds of solutions are obtained: one of which coincides with the result under the assumption $\alpha_- = 0$, the other yields $|\alpha_-| = 0.8$.

539

17423

POSSIBLE METHOD FOR DETERMINING THE PARITY OF THE CASCADE HYPERON. S.Barshay.

Phys. Rev., Vol. 120, No. 1, 265-6 (Oct. 1, 1960).

A study of the reaction $\Xi^+ + p \rightarrow K^+ + K^+$ is suggested as a possible means of determining the parity of the cascade hyperon relative to the nucleon. See also Abstr. 17415 of 1960.

539.

17424

THE Σ—Λ RELATIVE PARITY AND THE $\bar{K}$—N REACTION. Y.Nogami.

Progr. theor. Phys., Vol. 22, No. 1, 25-33 (July, 1959).

Possible resonances in pion—hyperon scattering at low energ are qualitatively examined and some noticeable differences are found between two cases in which the Σ—Λ relative parity is even and odd. Then, supposing that, in the process $\bar{K} + N \rightarrow \pi + Y$, the strong resonances of pion—hyperon scattering in the final state will dominate over the relatively weak K-meson interaction, the author discusses the possibility of whether the relative parities o K-meson and baryons can be derived from experiments on this process.

539.

17425

ANTIHYPERON PRODUCTION IN ANTINUCLEON—NUCLEON COLLISIONS NEAR THRESHOLD.

G.Domokos.
Nuovo Cimento, Vol. 15, No. 6, 983-5 (March 16, 1960).

The probability of production of various hyperon—antihypero pairs is calculated by the statistical model, for which some justification is given, as a function of the incident energy. The calculated cross-section for $\Lambda\bar{\Lambda}$ production agrees with the observed value. E.J.Squir

Strange particles

539

17426

PRODUCTION OF STRANGE PARTICLES BY 1.5-Be π^- MESONS IN C, Fe, AND Pb. T.Bowen, J.Hardy, Jr

G.T.Reynolds, C.R.Sun, G.Tagliaferri, A.E.Werbrouk and W.H.Moore.
Phys. Rev., Vol. 119, No. 6, 2030-41 (Sept. 15, 1960).

The production of $Y^0(\Lambda^0,\Sigma^0)$, θ^0, Σ^- particles by 1.5 BeV π^--mesons was observed in a multiplate cloud chamber with ½ in. pla of C, Fe, and Pb. The fraction of the inelastic nuclear interactio which result in strange particle production remains approximatel constant from C to Pb, with the following yields: Y^0, 1.7 ± 0.4%; θ^0, 1.4 ± 0.5%; Σ^-, 0.2 ± 0.1%. The production angular and mome tum distributions are given, along with the distributions obtained from Monte Carlo calculations which do not include secondary interactions of the strange particles. The yields of hyperons and θ^0's are close to those expected on the basis of the known cross-sections in elementary π—p collisions. However, the Σ^-/Y^0 ratio is observed to be much less than expected, indicating at least geometric cross-section for $\Sigma^- + p \rightarrow Y^0 + n$. The following lifetimes were obtained: Λ^0, $(2.72_{-0.27}^{+0.29}) \times 10^{-10}$ sec; θ_1^0, $(1.09_{-0.15}^{+0.19})$ 10^{-10} sec. No statistically significant Λ^0 decay asymmetries (up-down, forward-backward, decay proton scattering) were found. Four likely and two possible examples of θ_2^0 interactions were observed, in good agreement with the number expected if the interaction cross-section were geometric.

539.

17427

PRODUCTION OF STRANGE PARTICLES BY 2.8-BeV PROTONS IN C, Fe, AND Pb. T.Bowen, J.Hardy, Jr,

G.T.Reynolds, G.Tagliaferri, A.E.Werbrouk and W.H.Moore.
Phys. Rev., Vol. 119, No. 6, 2041-50 (Sept. 15, 1960).

Observations of Λ^0, θ_1^0, and $\Sigma_\pi^\pm$ particles from 2.8 BeV proto interactions were made in a multiplate cloud chamber with ½ in. plates of C, Fe, and Pb. The $Y^0(\Lambda^0,\Sigma^0)$ and θ^0 cross-sections, whe compared with those observed for production by 1.5 BeV π^--meso with the identical arrangement (see preceding abstract), are lowe by at least a factor of four for C and a factor of two for Pb. Production of $\Sigma_\pi^\pm$'s by protons and pions seem to be of comparable magnitude in either C or Pb. Since protons are less effective tha pions of similar kinetic energy (in the centre-of-mass system) in producing strange particles, it is estimated in the case of incident protons that indirect production of strange particles by intermedi pions accounts for (40_{-13}^{+28})% of the observed particles in C and

($_{-14}^{+21}$)% in Pb. The different A dependence of the proton and
cross-sections for producing observable strange particles
θ_1^0, $\Sigma_\pi^\pm \to \pi^\pm + n$) may be fitted by a total proton—nucleon
ect production cross-section of 0.09 ± 0.06 mb. The proton-
duced strange particle events were used to compute what would
expected when decay γ-rays emitted at 90° to the beam direction
observed in the geometry used by Berley and Collins. The
dicted decay curve is in excellent agreement with their observa-
s, and the absolute and relative yields agree within the estimated
erimental uncertainties.

iterons

539.12

17428 ANGULAR DISTRIBUTIONS OF THE D(d,n)He^3 REACTION FOR 5- TO 12-MeV DEUTERONS.

D.Goldberg and J.M.Le Blanc.
ys. Rev., Vol. 119, No. 6, 1992-9 (Sept. 15, 1960).
The absolute differential cross-section for production of mono-
ergetic neutrons by the D(d,n)He^3 reaction was measured with
, 7.6, 9.6, and 12.2 MeV deuterons. A proton recoil counter
escope was used to detect the neutrons and to separate neutrons
m the D(d,np)D breakup reaction. The angular distributions at
energies are very peaked in the forward direction, with a first
nimum around 30° to 40° and a subsequent smaller maximum.
e angular distributions, transformed to the centre-of-mass
stem, were fitted with the exchange stripping theory of Owen and
dansky, Abstr. 4720 of 1957; 4309 of 1958), in which stripping
m both incident and target deuterons is formally included.
cellent fits were obtained, but it was necessary to decrease
notonically the interaction radius, R_0, with incident deuteron
ergy. The variation was considerable, from R_0 = 8.4 ± 0.2 fermi
5.0 MeV to R_0 = 5.5 ± 0.2 fermi at 12.2 MeV. An isotropic
ntribution of about 3 mb/sr was added to each distribution to
tain the best fit.

539.12

17429 PHOTODISINTEGRATION OF THE DEUTERON IN THE MEDIUM ENERGY RANGE.

J. de Swart and R.E.Marshak.
ysica, Vol. 25, No. 10, 1001-15 (Oct., 1959).
Calculated for γ-ray energies in the laboratory from 9.23 to
2.4 MeV. Special attention is given to the range E_γ = 9.23 MeV
E_γ = 77.3 MeV, corresponding to nucleon—nucleon scattering in
e laboratory from 14 to 150 MeV. For the nucleon—nucleon inter-
tion the SM 1 potential is used; for the deuteron the Gartenhaus
uteron with 6.7% D state is assumed. The following are calcu-
ted: total cross-section; angular distribution for unpolarized as
ell as polarized γ-rays; polarization of outgoing nucleons for un-
larized γ-rays. Where possible, a comparison with experimental
sults is made. It is shown that the photodisintegration can impose
nditions on the phase shift sets that will permit one to rule out
everal of the proposed phase shift sets at 150 MeV nucleon—
cleon scattering.

539.12

17430 PHOTODISINTEGRATION OF THE DEUTERON AT HIGH ENERGIES. S.-H.Hsieh.

rogr. theor. Phys., Vol. 21, No. 4, 585-92 (April, 1959).
It is shown that the photodisintegration of the deuteron up to
bout 140 MeV can be well accounted for only by the nucleon parts,
many effects are correctly treated. It is pointed out that the
nfluence of the nature of the triplet odd state (which is the final
tate of the electric dipole transition) is remarkable, and the
ecessity of using exact multipole formulae at high energies is
mphasized.

539.12

17431 SOURCE OF POLARIZED DEUTERONS AND THE VERIFICATION OF ALIGNMENT WITH THE T(d,n)He^4 EACTION.

.Baumgartner, L.Brown, P.Huber, H.Rudin and H.R.Striebel.
hys. Rev. Letters, Vol. 5, No. 4, 154-6 (Aug. 15, 1960).
A source of polarized deuterons is described, capable of
elivering a beam of about 0.01 μA of deuterons after acceleration
rough 100 kV. The spin axis is parallel to the ion beam and the
euterons should, theoretically, have spin populations of $\frac{1}{3}$, $\frac{1}{3}$, $\frac{1}{3}$ for
euterons with m_d, the strong field quantum number, equal to +1, 0,
1, respectively. The polarization was detected by measuring the ratio of the differential cross-section at 0° to the beam, to that at 30°, 60° and 90° for neutron production by the T(d,n)He^4 reaction. The results were analysed in terms of the parameter G, the population ratio for spin state 0 to the sum of spin states +1 and −1. This should have the value 0.8. In practice the results were best fitted by the value G = (0.706 ± 0.014). Possible reasons for this slight depolarization are discussed. R.E.Meads

539.12 : 537.54

A VERY LOW VOLTAGE DEUTERON ACCELERATOR.

See Abstr. 17055

Tritons

539.12

17432 TENSOR AND L · S FORCES IN THE TRITON.

G.H.Derrick and J.M.Blatt.
Nuclear Phys., Vol. 17, No. 1, 67-73 (June (2), 1960).

A variational estimate is made of the triton binding energy for a potential developed by Gammel, Christian and Thaler (Abstr. 2997 of 1957), modified to include L · S forces. This potential, which is similar in many respects to potentials based in part on meson theory, is found to be too weak to bind the triton at all; the state of lowest energy is a deuteron and a free neutron. The proportion of P-states coupled in by the L · S forces is less than 0.001%.

539.12

17433 EFFECT OF HARD CORES ON THE BINDING ENERGIES OF H^3 AND He^3. CORRECTED VALUES.

T.Ohmura.
Progr. theor. Phys., Vol. 22, No. 1, 34-40 (July, 1959).

There was a slight error in the kinetic energy formula of a previous paper by Ohmura (formerly Kikuta), Morita, and Yamada (Abstr. 11514 of 1959). The binding energy of H^3 as well as the Coulomb energy of He^3 are recalculated by using the correct value of the kinetic energy. The results obtained are, however, almost the same as in Abstr. 8322 of 1956 and 11514 of 1959.

539.12

17434 ON THE CHOICE OF D-STATE WAVE FUNCTIONS IN TRITON CALCULATIONS. G.H.Derrick.

Nuclear Phys., Vol. 18, No. 2, 303-9(Aug.(2), 1960).

A set of D-state wave-functions with the correct asymptotic properties is suggested for use in variation calculations of the triton energy. The matrix elements of the kinetic and potential energy operators are evaluated for these functions.

539.12

17435 ELASTIC SCATTERING OF FAST NEUTRONS BY TRITIUM AND He^3.

J.D.Seagrave, L.Cranberg and J.E.Simmons.
Phys. Rev., Vol. 119, No. 6, 1981-91 (Sept. 15, 1960).

Differential cross-sections were obtained for the elastic scattering of neutrons by tritium and by He^3 at E_n = 1.0, 2.0, 3.5, and 6.0 MeV over the angular range 27° to 161° in the c.m. system. The Los Alamos large Van de Graaff accelerator and pulsed-beam time-of-flight facility were employed, and the scattering samples were contained in small thin-walled stainless steel spheres. One-third mole of He^3 was contained at 5000 lb/in^2 and one-half mole of tritium was prepared in the form of CaT$_2$. Absolute cross-sections were determined from a comparison with the scattering from a thin shell of CH$_2$ at each energy, together with calibration of the relative sensitivity of the detector as a function of energy by the known forward yield of the T(p,n)He^3 reaction. The angular distributions for n—T scattering are in excellent agreement with the calculations of Bransden, Robertson, and Swan based on a Serber exchange force. The n—He^3 measurements favour qualitatively the Serber rather than the symmetrical exchange force used in the calculations, but the agreement is poorer than that obtained for n—T scattering. The polarization of elastically scattered 1 MeV neutrons was found to be less than 5% for both samples, unlike the strong polarization observed in n—He^4 scattering.

COSMIC RAYS

(Nuclear reactions due to cosmic rays are included under Nuclear Reactions)

537.59

17436 "COSMIC RADIATION": THE FIFTY-FIRST KELVIN LECTURE. C.F.Powell.

Proc. Instn Elect. Engrs, Paper 3301, publ. Sept., 1960 (Vol. 107B, 389-94).

The present state of knowledge on the nature of cosmic radiation is outlined, with particular reference to the charge spectrum of the radiation and the supernovae theory of the origin of cosmic rays.

C.F.Barnaby

537.59

17437 HYDRODYNAMIC ORIGIN OF COSMIC RAYS. S.A.Colgate and M.H.Johnson.

Phys. Rev. Letters, Vol. 5, No. 6, 235-8 (Sept. 15, 1960).

It is suggested that a shock wave, arising from a sudden pressure increase in the core of an expanding supernova, intensifies as it advances into regions of lower density and imparts relativistic energies to particles in the outermost layers. A preliminary account is given of an investigation of this mechanism for the generation of cosmic radiation.

R.A.Newing

537.59

17438 ORIGIN OF COSMIC RAYS REVEALED IN THE RIGIDITY SPECTRUM OF PRIMARY PARTICLES.

S.Hayakawa and M.Koshiba.

Progr. theor. Phys., Vol. 21, No. 3, 473-5 (March, 1959).

In order to obtain rigidity spectra of nuclei as observed in the primary cosmic radiation from a spectrum of the thermal type, two processes are proposed, an acceleration process and another which is needed to cut off the lower energy part. The latter process is discussed in some detail. It is suggested that such a process may be operative steadily in some active region of the galaxy and consist of an absorption in the active region combined with a temporary confinement of particles by magnetic clouds.

E.W.Kellermann

537.59

17439 THE DIRAC MONOPOLE AS A CONSTITUENT OF PRIMARY COSMIC RADIATION. N.A.Porter.

Nuovo Cimento, Vol. 16, No. 5, 958-9 (June 1, 1960).

This note suggests that a number of effects which have been observed, in recent years, in large extensive air showers can be understood if it is assumed that a very small fraction, about 10^{-14}, of all primary cosmic ray particles are Dirac monopoles.

C.F.Barnaby

537.59

17440 SHOWER PRODUCTION AT SMALL THICKNESSES OF ABSORBER. L.Nagy.

Acta phys. Hungar., Vol. 9, No. 1-2, 63-72 (1958).

The first part of the Rossi curve was studied for Al, Fe, Cu and Pb. The number of showers produced by mesons and photons is approximately proportional to nZ^2 for all four elements. Other ionizing particles produce more showers in higher Z elements.

E.J.Burge

537.59

17441 THE DETERMINATION OF THE PHOTON—ELECTRON RATIO IN EXTENSIVE COSMIC RAY AIR SHOWERS, USING A CLOUD CHAMBER.

I.Dohán, T.Gémesy, T.Sándor and A.Somogyi.

Acta phys. Hungar., Vol. 9, No. 1-2, 97-103 (1958). In German.

The advantages of this method, compared with previous methods employing counters, are pointed out. The ratio is determined as 1.12 ± 0.04, but is subject to corrections which are as yet uncertain.

E.W.Kellermann

537.59

17442 ENERGY DETERMINATION OF HEAVY PRIMARIES IN NUCLEAR EMULSION. P.L.Jain.

Phys. Rev., Vol. 120, No. 1, 293-300 (Oct. 1, 1960).

The "knock-on electron" method was used to determine the energy per nucleon of the heavy primary particle. In this method, the energy of the primary particle is determined by measuring the emission angle and the energy of the knock-on electrons. The conditions for the reliable estimate of the primary energy by this method are discussed. This method is applied to 34 flat events, o primary energy between 3 and 30 BeV/nucleon and of charge Z > which make nuclear interactions and break up into 2 or more α- particles. The energy of the primary particle obtained by knock- electron method is then compared with the energy obtained by (a) opening angle of α-particles and by (b) relative scattering measur ments of α-particles. The results obtained by knock-on electron method are quite consistent, within the experimental error, with the results obtained by other methods.

537.

17443 A WORLD-WIDE STUDY OF THE DAILY VARIATION THE NUCLEONIC COMPONENT OF COSMIC RAYS.

J.Katzman and D.Venkatesan.

Canad. J. Phys., Vol. 38, No. 8, 1011-26 (Aug., 1960).

The semidiurnal component of the nucleonic intensity at Ottawa, Canada, is essentially a pressure effect for the 5 year pe 1955 to 1959. The diurnal variation is composed of the component due to pressure, and component that may be attributed to an anisotropy of the primary cosmic-ray particles. The results are confirmed by a comparative study of the data from 15 stations betwee the geomagnetic latitudes 83°N and 73°S. A world-wide barometr coefficient of −0.72% per mb was obtained from the semidiurnal component and this coefficient was used to correct the diurnal com ponent at all the stations. The average corrected diurnal variatio during the period of study common to all stations, August 1957 to October 1958, is 0.27% and occurs at 14 h 16 m solar time. There is considerable spread in both amplitude and phase angle amongst the various stations. The root mean square differences from the mean amplitude is ±0.05% and from the mean phase angle is ±10° (40 minutes in time). The difficulty of drawing definite conclusion about the anisotropy from short term studies of individual stations is pointed out.

537.5

17444 ATMOSPHERIC TEMPERATURE EFFECTS ON THE SOLAR DAILY VARIATION OF COSMIC RAY INTENSITY. J.J.Quenby and T.Thambyahpillai.

Phil. Mag. (Eighth Ser.), Vol. 5, 585-600 (June, 1960).

The solar diurnal variation of the cosmic ray meson intensity caused by the periodic solar heating of the atmosphere is derived from a comparison of the ionization chamber and neutron monitor data from Huancayo, Peru. The amplitude and the time of maximu are found to be 0.11% and 05.30 hr respectively. Recent meterological data, free from appreciable radiation errors, are found to in rough agreement with this result. Particularly good agreement is obtained in the phases which are both later than the value given by Dorman (1957) by about 4 hr. The inclusion of this temperatur correction enables the directional measurements at Mawson to be reconciled with the idea of a primary anisotropy.

537.

17445 THE DIURNAL SOLAR PERIODICITY OF THE COSMI RAYS. H.Debrunner, F.G.Houtermans and W.Lindt.

Arch. Sci. (Geneva), Vol. 13, No. 1, 141-9 (Jan.-March, 1960).
In French.

Reports measurements of neutrons produced in 13 cm of Pb b cosmic-ray nucleons at the Jungfraujoch from Oct., 1958 to July, 1959. The variation was ±4% with a minimum at 01.00 hr and a maximum at 15.00 hr local time. The results are discussed in terms of a loss of primary particles in their passage near the sun

E.J.Bur

537.5

17446 DIURNAL VARIATION IN COSMIC-RAY INTENSITY, 1937-1959, AT CHELTENHAM (FREDERICKSBURG), HUANCAYO, AND CHRISTCHURCH. S.E.Forbush and D.Venkate

J. geophys. Res., Vol. 65, No. 8, 2213-26 (Aug., 1960).

The 24 hour and 12 hour waves in cosmic-ray intensity at Cheltenham (Fredericksburg), Huancayo, and Christchurch and their variability were analysed statistically, using data, corrected for pressure, for the period 1937-1959 from Compton—Bennett ionization chambers. The degree of correlation between the deviations of yearly mean 24 hour waves (from their 23 year means) at any two of the stations was almost as great as can be expected wh account is taken of the noise level inherent in the instruments. The deviations of yearly means, from their 23 year averages, indicated large secular variations which may be due to a quasi-systematic 22 year variation. The phase difference between these yearly deviation vectors at Huancayo and Cheltenham (or Christchurch) was considerably less than that between the average vecto

23 years. The statistical reality of the 12 hour wave was defi- ely established at all three stations, although, at least at Huan- yo, the average 12 hour wave probably resulted entirely from stematic errors due to exceedingly small frictional effects in barograph.

537.59

17447 LOW ENERGY SPECTRUM OF THE SEA LEVEL ELECTRONS AND MUONS AT 12°N.
Mishra (Basu) and M.S.Sinha.
dian J. Phys., Vol. 33, No. 8, 335-45 (Aug., 1959).

The slow electron and muon components of cosmic rays at sea vel and 12°N geomagnetic latitude have been studied with a multi- ate cloud chamber triggered by a coincidence—anti-coincidence stem. The differential energy spectra of these electrons have en obtained for energies between 5-300 MeV. The electron spec- um is found to be represented by a simple power law of the form $^{-1.2}$. In the range interval 7-60 g cm^{-2} of air equivalent the fferential range spectrum of muons has also been determined. The ectrum is found to be flat with a mean intensity (5.89 ± 0.15) 10^{-6}/g sec. sterad in the range interval 15-60 g cm^{-2} of air uivalent. Below this range the muon intensity falls off gradually. comparison of the total intensities of muons and electrons has also en given.

537.59

17448 LOCAL INCREASE OF INTENSITY OF COSMIC RADIATION. J.P.Legrand and A.Helary.
ture (London), Vol. 187, 397-8 (July 30, 1960).

Details are given of an increase in intensity of cosmic radiation corded at the Paris Cosmic Ray Survey station on Dec. 4, 1957.

C.F.Barnaby

537.59

17449 ON THE ANISOTROPY OF THE COSMIC RADIATION. E.W.Kellermann and M.S.Islam.
uovo Cimento, Vol. 17, No. 3, 334-42 (Aug. 1, 1960).

An attempt has been made to reproduce some results of cCusker and his coworkers who had reported diurnal effects of smic-ray showers. The design of the apparatus follows closely at of these workers, but allows more detailed information about ch recorded event to be obtained. The main categories of observ- events, including those examined by McCusker et al., show no gnificant diurnal variation. A possible sidereal diurnal variation a particular group of events is critically examined, and it is ncluded that, in spite of strong statistical weight, the implications accepting the variation as physically real do not at present allow to be regarded as such.

537.59

17450 ON THE COSMIC RAY STORMS OF JULY 1959. D.Cattani and M.Galli.
uovo Cimento, Vol. 16, No. 4, 765-9 (May 16, 1960).

Events measured between July 6-25, 1959, by two cosmic-ray cintillator monitors at Bologna (geomagnetic latitude 44.5°N, 50 m bove sea-level)under 450 g cm^{-2} of concrete are plotted and, eparately, data of July 11, 15 and 17, when decreases of rates ere observed. A correlation between 3^{+} flares associated with adio burst and Forbush decreases is pointed out. Peculiar fea- ures shown by the July 15 data are discussed, some of which seem o correspond to short decreases observed at Deep River and at obart.

E.W.Kellermann

537.59

17451 OBSERVATION OF A SHORT-LIVED COSMIC-RAY SOLAR FLARE INCREASE WITH A HIGH-COUNTING- ATE MESON DETECTOR. R.A.R.Palmeira and K.G.McCracken.
hys. Rev. Letters, Vol. 5, No. 1, 15-16 (July 1, 1960).

This increase was observed at M.I.T. (41°23'N, 71°08'W, ea-level) on May 4, 1960 by three large meson telescopes with 5 cm of lead between the scintillators. It is estimated that the ncrease began after 10:30:53, and a maximum counting rate, 6% bove the pre-event value, was attained at about 10:35 U.T. The ounting rate remained at this value for about 5 min, then returning apidly to the pre-event value. Certain conclusions are drawn from hese results.

E.W.Kellerman

537.59 : 523.2

17452 COSMIC-RAY INTENSITY VARIATIONS AND THE INTERPLANETARY MAGNETIC FIELD. H.Elliot.
hil. Mag. (Eighth Ser.), Vol. 5, 601-19 (June, 1960).

It is shown that the general characteristics of the cosmic-ray intensity variations can be explained in terms of a large-scale interplanetary magnetic field of predominantly dipole character but containing small-scale irregularities which act as scattering centres. It is suggested that the cosmic-ray data can be taken as evidence for the existence of such a field. The strength of the field, which is generated by current systems in the solar corona, is dependent on the level of solar activity but must in general be in the region of 10^{-5} to 10^{-4} G at the earth's orbit.

537.59 : 525

17453 PRELIMINARY RESULTS FROM THE SPACE PROBE PIONEER V. C.Y.Fan, P.Meyer and J.A.Simpson.
J. geophys. Res., Vol. 65, No. 6, 1862-3 (June, 1960).

Some measurements obtained with the energetic particle detectors on Pioneer V, in comparison with simultaneous measurements with a series of four neutron monitor piles on earth, are briefly reported. The measurements include (1) the direct detection of particles accelerated in solar flares, where not only protons but electrons and/or γ-rays were found, (2) evidence for the solar production of energetic electrons by processes other than solar flares, and (3) additional evidence showing that the Forbush-type decreases do not require the presence of the earth and its magnetic field.

A.Boksenberg

537.59

17454 ANTI-RIME ROOF FOR COSMIC RAY OBSERVATION. I.Kamei.
Technol. Rep. Tohoku Univ., Vol. 24, No. 1, 19-25 (1959).

537.59 : 539.1.07

17455 TRIGGERED SPARK COUNTER ARRAYS OF LARGE AREA (SQUARE METERS) FOR EXPERIMENTS ON VERY HIGH ENERGY COSMIC RAY PARTICLES.
N.B.Mistry, G.T.Murthy, P.V.Ramana Murthy and B.V.Sreekantan.
Nuovo Cimento, Vol. 17, No. 3, 429-37 (Aug. 1, 1960).

The constructional and operational features of triggered spark counters of large area are described. These counters are being used, in conjunction with nuclear emulsions, in experiments on high energy nuclear interacting particles which arrive simultaneously over large areas, sometimes associated and at other times unassociated with air showers. For these experiments, the spark counters and emulsions are being used in arrays covering an area of a few square metres.

537.59 : 551.5

STAR PRODUCTION BY TRAPPED PROTONS IN THE INNER RADIATION BELT. See Abstr. 16457

537.59 : 523.16

THE RELATION OF COSMIC RADIO EMISSION TO THE ELECTRONIC COMPONENT OF COSMIC RAYS. See Abstr. 16528

NUCLEUS

539.14

17456 SHORT-RANGE CORRELATIONS IN NUCLEAR WAVE FUNCTIONS. F.Coester and H.Kümmel.
Nuclear Phys., Vol. 17, No. 3, 477-85 (July (1), 1960).

It is assumed that the ground-state wave-function of a closed-shell nucleus is approximated by a Slater determinant in the restricted region of configuration space where all internucleon distances are larger than a certain "healing distance". The remainder of the wave-function is given in terms of a series of cluster functions. The overlap integral between the correct wave-functions and the Slater determinant is small and depends on the higher cluster functions in a complicated manner. Nevertheless, one can show that the one- and two-body density matrices are well approximated by expressions involving only the single-particle wave-functions and the two-body cluster functions. The Schrödinger equation yields a coupled set of equations which determine the cluster functions as well as the single-particle wave-functions.

539.14

17457 CENTRAL THREE-BODY FORCES IN HEAVY NUCLEI. R.C.Smith and R.T.Sharp.
Canad. J. Phys., Vol. 38, No. 9, 1154-67 (Sept., 1960).

Three-nucleon potentials are calculated using the renormalized static theory of Chew and Low. These potentials are used to evaluate the three-body contribution to the total energy per nucleon in nuclear matter as a function of nuclear density. It is found that while the three-body energy is greater than that predicted by unrenormalized theories by about one order of magnitude as a result of multiple-scattering effects, its dependence on the nuclear density in the region of the equilibrium density is very weak. Three-body forces are therefore not expected to change the saturation properties of nuclear matter as predicted by a hard core potential to any appreciable extent.

539.14

17458 PAIRING PLUS LONG RANGE FORCE FOR SINGLE CLOSED SHELL NUCLEI.

L.S.Kisslinger and R.A.Sorensen.

K. Danske Vidensk. Selsk. mat. fys. Skr., Vol. 32, No. 9, 82 pp.(1960).

The low energy properties of nuclei are calculated, using a model which combines certain important features of the unified nuclear model and the independent-particle model with a two-body residual interaction. The residual interaction used has two parts, a pairing force and a long-range part. Calculations are made for nuclei with a major closed proton or neutron shell, $A > 48$, for various values of the two strength parameters, using single-particle levels taken from experimental results. In each region, the calculated energy levels and spins agree in considerable detail with systematic experimental data. In addition, the even—odd A mass difference, the electromagnetic transition rates, and other properties are calculated and compared with experiment. The approximate 1/A dependence of the parameters is consistent with a volume force.

539.14

17459 NATURES OF NUCLEAR FORCES INDICATED BY THE PHOTODISINTEGRATION OF THE DEUTERON. IV.

S.H.Hsieh.

Progr. theor. Phys., Vol. 21, No. 1, 211-12 (Jan., 1959).

For Pt III, see Abstr. 15501 of 1960. Results of a calculation at 90 MeV photon energy are presented. D.W.L.Sprung

539.14

17460 A NOTE ON THE SPECIFICATION OF NUCLEAR POTENTIALS. T.Hamada.

Progr. theor. Phys., Vol. 20, No. 1, 114-15 (July, 1958).

More accurate values for the numerical constants in the Gaussian, Exponential and Yukawa forms of the phenomological nucleon—nucleon potential are reported. J.S.Dowker

539.14 : 539.11

17461 PARITY NONCONSERVING INTERNUCLEON POTENTIALS. II. EFFECTS IN ELECTROMAGNETIC TRANSITIONS. R.J.Blin-Stoyle.

Phys. Rev., Vol. 120, No. 1, 181-9 (Oct. 1, 1960).

For Pt I, see Abstr. 12862 of 1960. A detailed investigation is made of the way in which parity-nonconserving (PNC) internucleon potentials lead to parity impurities in nuclear states and hence to pseudoscalar asymmetries in the emission of gamma radiation. Explicit expressions are obtained for the angular distribution of unpolarized radiation (a) in emission from nuclei polarized by non-nuclear methods, (b) in $\beta-\gamma$ angular correlations, (c) in polarized thermal neutron capture radiation and also for the magnitude of the circular polarization of radiation from an arbitrarily oriented nuclear system. The magnitudes of these effects are then estimated for the case of a transition between low-lying nuclear states and also for a ground-state transition following neutron capture. Finally a critique for the γ-ray transitions so far used in experimental investigations of PNC effects is given. It is concluded that many transitions in particularly simple nuclei are insensitive to PNC effects and that at present all that can be stated with any confidence is that $\mathfrak{F} \leq 10^{-4}-10^{-5}$.

539.14

17462 STATISTICAL NUCLEI WITH REPULSIVE CORE INTERACTION. T.Ishidzu.

Progr. theor. Phys., Vol. 21, No. 5, 766-8 (May, 1959).

Investigates the use of a two-body potential with a repulsive core (the difference of two Yukawa potentials) in statistical theory calculations. R.J.N.Phillips

539.14

17463 NOTE ON THE EFFECT OF THE NUCLEAR ENERGY GAP ON THE OPTICAL MODEL POTENTIAL.

J.Sawicki.

Nuovo Cimento, Vol. 15, No. 3, 504-7 (Feb. 1, 1960).

The effect on the optical model potential of nuclear matter o an energy gap arising from pair correlations is estimated. It is concluded that the effect is negligible. J.Goldst

53

17464 NOTE ON THE SPIN—ORBIT PART OF THE OPTIC MODEL POTENTIAL. J.Sawicki.

Nuclear Phys., Vol. 17, No. 1, 89-95 (June (2), 1960).

The spin—orbit part of the optical model potential is calcula using a modified, more accurate form of the impulse approximat model of Riesenfeld and Watson (Abstr. 6151 of 1956). In contra to the usual model the integrations over the target particle mom tum are performed. Comparison with the usual theories is discussed and the polarization of nucleons elastically scattered fron carbon nuclei is dealt with using Signell—Marshak (Abstr. 2468 o 1958) nucleon—nucleon scattering phase shifts.

53

17465 SPIN—ORBIT SPLITTING AND TENSOR FORCE. A.Arima.

Nuclear Phys., Vol. 18, No. 2, 196-223 (Aug. (2), 1960).

The second-order effect of the tensor force is calculated in nuclei which have several nucleons outside closed shells. This second-order effect causes a modification of the first-order sec equation of the degenerate shell-model states $(nl)^p$, where nl is a orbit of the L—S coupling shell model and p is the number of nucleons outside closed shells. This modification is equivalent t the introduction (a) of a slight change in the one-particle energy; (b) of one-body spin-orbit interaction $\Sigma \xi s_i \cdot l_i$; (c) of effective no local two- and three-body forces, and (d) of an energy depressio that is common to all states. Here $\xi = C_0 + (p-1)C_1$, where C_0 C_1 are constant as long as the average potential of the shell mode does not change. C_0 and C_1 are calculated in the (1p)-shell, and $C_0 \cong 4C_1$. The constant C_0 is about −1.0 to −1.5 MeV. In this numerical calculation, the harmonic-oscillator wave functions ar adopted as individual wave functions, and either the tensor force suggested by meson theory or the phenomenological strong tenso force is assumed. It is very interesting to note that $\xi(N^{15})/\xi(He^{5}$ $\cong 3.5$. If the three-body effect is neglected, the modified secular equation results in the intermediate-coupling shell-model Hamilton provided that the two-body effective potential is replaced by the usua potential which has the same matrix elements as the effective on

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17466 STUDY OF THE NUCLEAR FIELD WITH A RIGID (PROTONIC) CHARGE DISTRIBUTION BY MEANS OF THE GENERAL THEORY OF RELATIVITY. J.Gottlieb.

C.R. Acad. Sci. (Paris), Vol. 250, No. 22, 3588-90 (May 30, 1960). In French.

The nucleus is assumed to consist of a core of constant char density surrounded by a shell throughout which the charge density decreases as a one-sided Gaussian function. The space-time me throughout the nucleus is determined by the Einstein field equati with the gravitational constant replaced by a parameter which is found to depend upon the nuclear specific charge and the dielectri constant. R.A.New

539

17467 SUPERFLUID MODEL OF THE NUCLEUS. V.G.Solov'ev.

Dokl. Akad. Nauk SSSR, Vol. 133, No. 2, 325-8 (July 11, 1960). In Russian.

The effect of pairing forces on deformed nuclei is considere It is found that the "energy gap" depends significantly on the stat of excitation of the nucleus. The ordering of levels in odd nuclei altered by the pairing force, since hole levels and particle levels behave differently; the excited states are generally reduced in energy by the pairing force. In even nuclei, the excitation energi increase as the force gets stronger. The pairing energy is calculated, and the result is compared with experiment to estimate the strength of the pairing force. Corrections to the transition probabilities are estimated. D.J.Thoul

539.

17468 QUASI-DEUTERON MODEL OF ATOMIC NUCLEI. T.Tagami.

Progr. theor. Phys., Vol. 21, No. 4, 533-60 (April, 1959).

The quasi-deuteron model is investigated, taking account of correlation functions in the nuclear ground-state wave-function. This formalism makes it possible for the cluster development method to be used conveniently for the calculation of expectation values or matrix elements by the model wave-functions. Pair leon correlation functions are determined phenomenologically, self-consistently, by making use partly of the experimental rmation about two-nucleon systems and partly of the theoretical siderations for multiple scattering problems developed by eckner, Bethe and their collaborators. In this paper the pro- ties of nuclear matter are investigated as a preliminary dis- sion. Two-nucleon correlation functions are investigated in ail for every possible spin and isospin states of the nucleon rs. The effect of the exclusion principle on these correlation ctions is given in explicit form and it is shown that on the one d the exclusion principle plays the most important role for the earance of the shell structure, and that on the other hand it may e some relationships with alpha-particle formation on the nuclear face. The saturation of nuclear volume energy and that of lear density are discussed quantitatively using the ground- te wave-function, and the velocity dependent one-particle poten- . is constructed self-consistently. High-energy nuclear reactions, ch the independent particle model without correlation fails to lain, are discussed and it is shown that the nucleon momentum tribution in nuclei is given correctly by this model.

539.14

17469 MATRIX ELEMENTS IN NUCLEAR SHELL THEORY.

T.A.Brody, G.Jacob and M.Moshinsky.

clear Phys., Vol. 17, No. 1, 16-29 (June (2), 1960).

In a previous paper (Abstr. 5517 of 1960) transformation brackets the harmonic-oscillator function were defined and used for the luation of matrix elements for nuclear forces. Numerical tables the transformation brackets are now available. The purpose of s paper is to show how these tables, combined with those given in present note, can be used to evaluate the matrix elements of clear-shell theory directly in terms of Talmi integrals. For com- rison between present methods and those used previously, a lation between Slater coefficients and Talmi integrals is also ob- ned.

539.14

17470 APPLICATION OF THE PHASE SPACE QUASI-PROBABILITY DISTRIBUTION TO THE NUCLEAR ELL MODEL.

G.A.Baker, Jr, I.E.McCarthy and C.E.Porter.

ys. Rev., Vol. 120, No. 1, 254-64 (Oct. 1, 1960).

The quantum mechanical joint position—momentum quasi- stribution function is applied to the nuclear shell model. By intro- cing approximate quasi-position and quasi-momentum variables, e quasi-distribution function is converted into a non-negative (and nce nonquasi) distribution. Numerical results are presented for e-dimensional and three-dimensional potentials leading in three mensions to a nonisotropic nonindependent distribution with a edominance of low momenta at the nuclear surface. These results e in contrast with the usual Thomas—Fermi model and in addition ovide a simple base for the discussion of direct nuclear reactions volving an average over many states of a residual nucleus for hich linear momentum as opposed to angular momentum is a rele- nt quantity.

539.14

17471 AN ILLUSTRATIVE EXAMPLE OF THE NUCLEAR COLLECTIVE MOTION.

F.Iwamoto.

ogr. theor. Phys., Vol. 20, No. 5, 776-7 (Nov., 1958).

A system of bosons in a two-dimensional well is considered. e interaction is a quadrupole two-particle attraction, coupling just o levels, an s-level and a d-level. The system shows different haviour according to the sign of (T — 2NV), where T is the perturbed energy difference between the s and d levels, N is the mber of particles and V is the strength of the interaction. The stem has vibrational modes and, in the strong coupling case, tational modes also appear.

E.J.Squires

539.14

17472 EFFECT OF QUADRUPLE CORRELATIONS IN LIGHT NUCLEI.

V.G.Soloviev.

uclear Phys., Vol. 18, No. 1, 161-72 (Aug. (1), 1960).

Quadruple correlations of nucleons having equal energies are nsidered on the basis of the effective Hamiltonian describing the teraction of nucleon pairs. It is shown that the formation of adruple correlations in light nuclei is energetically favoured if e interaction among pairs is attractive. Certain laws in the binding nergy of the last neutron in light nuclei are explained by taking into ccount pair and quadruple correlations. A criterion obtained shows t what excess of the number of neutrons over that of protons in table nuclei, as a result of the parting of the Fermi surfaces, some uter neutrons cease to participate in quadruple correlations, which ads to the disappearance of explicit α-particle properties of nuclei.

539.14

17473 MOMENTUM DEPENDENCE OF THE HEALING DISTANCE.

T.Tagami.

Progr. theor. Phys., Vol. 21, No. 3, 465-8 (March, 1959).

A simple estimate is given of the "healing distance" for the wave-functions of pairs of particles embedded in nuclear matter.

J.Goldstone

539.14

17474 NEUTRON AND PROTON DENSITIES IN NUCLEI AND THE SEMI-EMPIRICAL MASS FORMULA.

A.R.Bodmer.

Nuclear Phys., Vol. 17, No. 3, 388-420 (July (1), 1960).

The semi-empirical statistical method due to Wilets, with the use of trial nucleon densities, was used to investigate the nucleon density distributions and their relation with the semi-empirical mass formula. In particular those features depending on the neutron excess were isolated, especially the difference in extension δ between the neutron and proton densities and the surface symmetry energy $E_{s\tau}$. In addition to the usual Weiszäcker-type gradient terms, a new mixed gradient term had to be introduced. For both δ and $E_{s\tau}$ the density dependence of the symmetry energy density ϵ_τ plays an important role, while $E_{s\tau}$ also depends on δ. The variational solution for δ together with the empirical value of $E_{s\tau}$ then determine both δ and the density dependence of ϵ_τ in terms of the magnitudes of the gradient terms. The general conclusions are independent of these magnitudes if these are consistent with the empirical surface energy and thickness. For stable nuclei, $\delta \propto (N - Z)/A$ to a good approximation; δ is small ($\leq 0.3 \times 10^{-13}$ cm) even for the heaviest stable nuclei, the neutrons thus extending slightly beyond the protons. The density dependence of ϵ_τ is found, tentatively, to be considerably smaller than in the independent-particle approximation for nuclear matter. The empirically used dependence for $E_{s\tau} \propto (N - Z)^2/A^{4/3}$ seems well justified for nuclei near the stable valley. The dependence of the total surface thickness on the neutron excess is found to be quite small.

539.14 : 539.18

MASSES OF 200 NUCLEI FROM Sm TO Rn. See Abstr. 17673

539.14

17475 ON THE THEORY OF THE NUCLEAR MOMENT OF INERTIA.

Yu.K.Khoklov.

Zh. eksper. teor. Fiz., Vol. 37, No. 4(10), 1136-7 (Oct., 1959). In Russian. English translation in: Soviet Physics—JETP (New York), Vol. 37(10), No. 4, 808-9 (April, 1960).

The expression for determining the nuclear moment of inertia given by Villars (Abstr. 9327 of 1957; 1697 of 1959) and Hayakawa and Marumori (Abstr. 11297 of 1960), is shown to be equivalent to that given by Inglis (Abstr. 1110 of 1955) and Bohr and Mottelson (Abstr. 8507 of 1959).

E.A.Sanderson

539.14

17476 ROTATIONAL ENERGIES AND MOMENTS OF INERTIA OF NON-AXIAL NUCLEI.

A.S.Davydov, N.S.Rabotnov and A.A.Chaban.

Nuclear Phys., Vol. 17, No. 1, 169-74 (June (2), 1960).

It is shown that the ratios of rotational energies of a non-axial nucleus, depending on the ratios of energies of two rotational states with spin 2, change little with the deviation of nuclear moments of inertia from their hydrodynamic values.

539.14

17477 DETERMINATION OF B_p, B_n IN THE REGION: Z = 49 TO Z = 54.

A.Basu.

Indian J. theor. Phys., Vol. 5, No. 1, 1-10 (March, 1957).

A large number of unknown B_p and B_n values has been calculated by sum rule in the region Z = 49 to Z = 54. In some cases, these calculated values have been checked and some new B_p, B_n values have been calculated by beta decay energy, positron decay energy or artificial reaction energy, in the above mentioned region.

539.14

17478 GRAPHICAL DETERMINATION OF B_p, B_n. II.

S.P.Banerjee.

Indian J. theor. Phys., Vol. 5, No. 3, 63-76 (Sept., 1957).

For Pt I see Indian J. theor. Phys., Vol. 4, 77 (1956). Fourteen new values of B_p, B_n have been found out from a graphical study of binding energies of the last neutron and proton in nuclei. In Pt I smooth curves for B_p, B_n were obtained by choosing suitable parameters. The smoothness is also shown in the present case. The range selected is from Z = 19 to Z = 25 and N = 20 to N = 26.

539.14

17479 **ON THE SMOOTHNESS OF B_p, B_n GRAPHS.**
S.Banerjee.
Indian J. theor. Phys., Vol. 5, No. 4, 111 (Dec., 1957).

539.14

17480 **THE NUCLEAR SPINS OF I^{126}, I^{132}, I^{133} AND I^{135}.**
H.L.Garvin and E.Lipworth.
Nuclear Phys., Vol. 19, No. 2, 140-7 (Oct. (1), 1960).

Some recent results are reported of a continuing programme to determine the nuclear spins, magnetic moments and electric quadrupole moments of the radioactive halogen isotopes by the method of atomic beams (Abstr. 569 of 1959). This work completes the measurement of the nuclear spins of the series I^{123} to I^{135} with the exception of the 52 min I^{134} isotope. The nuclear spins of I^{126}, I^{132}, I^{133} and I^{135} are 2, 4, $\frac{7}{2}$ and $\frac{7}{2}$, respectively.

539.14 : 539.18

EVIDENCE FOR ZERO SPIN OF Ne^{20}. See Abstr. 17669

539.14 : 539.16

17481 **THE g-FACTOR OF THE 92 keV LEVEL AND OTHER ANGULAR CORRELATION MEASUREMENTS ON Pm^{147}.**
E.Bodenstedt, H.J.Körner, F.Frisius, D.Hovestadt and E.Gerdau.
Z. Phys., Vol. 160, No. 1, 33-46 (1960). In German.

The gyromagnetic ratio was determined by a measurement of the 32± keV angular correlation in an external field of 15 000 G. The result; $g = +1.42 \pm 0.20$ implies corrections for the paramagnetism of the 4f-electron shell and for a time-dependent attenuation by internal fields. A new determination of the half-life of the 92 keV level confirmed the known value. The half-life of the 412 keV level was found as $T_{1/2} \leq 5 \times 10^{-10}$ sec. The following angular correlations were measured:

321 keV-92 keV cascade:

$$W(\Theta) = 1 - (0.087 \pm 0.008)\, P_2 - (0.001 \pm 0.003)\, P_4$$

441 keV-92 keV cascade:

$$W(\Theta) = 1 + (0.065 \pm 0.010)\, P_2 - (0.010 \pm 0.015)\, P_4$$

400 keV-92 keV cascade:

$$W(\Theta) = 1 - (0.023 \pm 0.008)\, P_2 - (0.002 \pm 0.009)\, P_4$$

277 keV-92 keV triple cascade:

$$W(\Theta) = 1 + (0.0016 \pm 0.0027)\, P_2 - (0.002 \pm 0.003)\, P_4$$

277 keV-321 keV cascade:

$$W(\Theta) = 1 + (0.0117 \pm 0.0025)\, P_2 - (0.0067 \pm 0.0033)\, P_4$$

120 keV-321 keV cascade:

$$W(\Theta) = 1 - (0.029 \pm 0.011)\, P_2 - (0.031 \pm 0.012)\, P_4$$

400 keV-198 keV cascade:

$$W(\Theta) = 1 - (0.067 \pm 0.009)\, P_2 + (0.001 \pm 0.011)\, P_4.$$

The spins and multipolarities of different γ-transitions are derived from these results.

539.14 : 539.16

17482 **GYROMAGNETIC FACTORS OF DEFORMED ODD-MASS NUCLEI WITH $153 \leq A \leq 187$.**
E.M.Bernstein and J.De Boer.
Nuclear Phys., Vol. 18, No. 1, 40-5 (Aug. (1), 1960).

Recently available experimental data are combined to obtain accurate values of the reduced magnetic dipole transition probabilities between rotational states of deformed odd-mass nuclei. These results are interpreted on the basis of the rotational model to yield the gyromagnetic factors g_R and g_K. It appears that the values of g_R vary rather smoothly with the atomic number and have a minimum at $A \cong 170$, and that g_R is smaller for odd neutron nuclei than for odd proton nuclei.

539.14 : 539.17

17483 **$B^{10}(d,p)B^{11}$ REACTION AND THE CONFIGURATIONS OF B^{11}.** O.M.Bilaniuk and J.C.Hensel.
Phys. Rev., Vol. 120, No. 1, 211-23 (Oct. 1, 1960).

A study of the states of B^{11} was made by high-resolution measurements of angular distributions and relative intensities of proton groups from $B^{10}(d,p)B^{11}$. The use of Butler analysis and calculated reduced widths lead to the following spin and parity assignments for excited states: 2.14 MeV, $\frac{1}{2}-$; 4.46 MeV, $\frac{5}{2}-$; 5.03 MeV, $\frac{3}{2}-$; 6.76 MeV, $\frac{7}{2}-$; 8.57 MeV, $(\frac{1}{2}+)$; 8.92 MeV, $\frac{5}{2}+$; 9.19 MeV, $\frac{7}{2}+$; 9.28 MeV, $\frac{5}{2}+$. The states of B^{11} exhibit a subdivision into three classes. The first f levels from ground state to 6.76 MeV, all of odd parity, correspo closely to the theoretical predictions of Kurath. The next four states of 6.81, 7.30, 7.99, and 8.57 MeV presumable result from highly mixed configurations which is evidenced by their weak str ping intensities. The third group consists of three single-particl states of even parity at 8.92, 9.19, and 9.28 MeV. The latter two states form a jj-double level arising from the configuration $p^6 2s$.

539.14 : 539

17484 **ATOMIC-BEAM MEASUREMENT OF THE HYPERFI STRUCTURE AND NUCLEAR MOMENTS OF IODINE-1**
E.Lipworth, H.L.Garvin and T.M.Green.
Phys. Rev., Vol. 119, No. 6, 2022-5 (Sept. 15, 1960).

The nuclear magnetic dipole and nuclear electric quadrupole interaction constants a and b were measured in 8 day I^{131} by an atomic beam magnetic resonance experiment. The results are $a = 575.903 \pm 0.007$ Mc/s, $b = 578.866 \pm 0.075$ Mc/s. The zero-field hyperfine splittings computed from these values of a and b are $\Delta\nu(5,4) = 3292.99 \pm 0.09$ Mc/s, $\Delta\nu(4,3) = 2138.22 \pm 0.05$ Mc/ $\Delta\nu(3,2) = 1314.24 \pm 0.07$ Mc/s. The nuclear magnetic dipole mon and nuclear electric quadrupole moment are calculated as $\mu_{131} = 2.738 \pm 0.001$ n.m., $Q_{131} = -0.41 \pm 0.01 \times 10^{-24}$ cm^2. The value of μ_{131} obtained here differs slightly from that obtained by other workers, while the value of Q confirms an earlier measurement made by a different method.

539.14 : 539

COLLECTIVE QUADRUPOLE EFFECTS IN LIGHT NUCLEI. See Abstr. 17552

539.14 : 539

SIZE OF GOLD AND BISMUTH NUCLEI. See Abstr. 17613

539.14 : 539.

17485 **NUCLEAR POLARIZATION IN A MESIC DEUTERIUM ATOM.** M.Demeur and C.Joachain.
Nuclear Phys., Vol. 17, No. 2, 329-38 (June (3), 1960). In French

The energy-shift due to polarization of the deuteron by a bou μ-meson was evaluated. This effect nearly compensates the ener shift caused by the finite extension of the nucleus. Finite extensio of the nucleons and D-state of the deuteron were neglected.

539.14 : 539

STATISTICAL PROPERTIES OF ATOMIC AND NUCLEAR SPECTRA. See Abstr. 17696

539

17486 **THE COULOMB ENERGIES OF LIGHT ATOMIC NUCLEI.** J.Jänecke.
Z. Phys., Vol. 160, No. 2, 171-85 (1960). In German.

A compilation of the known data on Coulomb energy differenc of isobaric doublets and isobaric triplets is given. Plots of the Coulomb energy differences versus $\bar{Z}/A^{1/3}$ with $\bar{Z} = (Z_1 + Z_2)/2$ sho an analogous shell structure behaviour for the three series with $2\bar{Z} = A - 1$, A and $A + 1$ ($T = 1$, $\frac{1}{2}$ and 1), i.e. discontinuities at th closed shells at $A = 4$, 16 and 40 and the closed subshell at $A = 32$ and oscillations mainly being due to Coulomb proton—proton pairi energy. A positive energy shift of the lowest states with $T = 1$ of all self-conjugate nuclei with $A = 4n + 2$ seems to be indicated by the experimental data. A semi-empirical formula is given that describes the data.

539

17487 **ON THE THEORY OF MULTIPLE COULOMB EXCITATION WITH HEAVY IONS.** K.Alder and A.Winther.
K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 32, No. 8, 72 pp. (1960).

Formulae and tables for the evaluation of multiple Coulomb excitation cross-sections of rotational and vibrational states. Fo other cases, general calculational procedures have been develope and these are illustrated through examples. The collision time is assumed to be short compared to the nuclear period. The investigation is further simplified by an approximate treatment of the dependence of the cross-section on the deflection angle of the projectile. The accuracy of the approximations is also discussed.

539.

17488 **TIME DEPENDENCE OF RESONANTLY FILTERED GAMMA RAYS FROM Fe^{57}.**
F.J.Lynch, R.E.Holland and M.Hammermesh.
Phys. Rev., Vol. 120, No. 2, 513-20 (Oct. 15, 1960).

The time dependence of gamma-rays emitted by the 14.4 keV

of Fe^{57} was studied by delayed-coincidence measurements
een a 123 keV gamma ray preceding formation of the state and
4.4 keV gamma-ray from the state. When no filter was used,
umber of gamma-rays decreased exponentially with the known
life of 0.1 μsec. When a foil of Fe^{57} (which was resonant to
keV radiation) was used as a filter, the number of gamma-rays
rved through the filter did not decrease exponentially. Instead,
ilter absorbed almost none of the gamma-rays first emitted by
4.4 keV state; at later times the absorption increased. Data
taken with three different thicknesses of absorber and with
sion and absorption peaks separated by 0 to 11 times the width
e resonance. The energy separation resulted from the Doppler
associated with a constant velocity between source and absor-
These data were, for the most part, in good accord with the
iction of a theory based on a classical model for absorber and
ce. In particular, the results verified the theoretical predic-
that at certain times the intensity of radiation observed would
reater with the filter than without it.

539.14

7489 MÖSSBAUER EFFECT IN Fe^{57} AT VERY LOW TEMPERATURES. J.G.Dash, R.D.Taylor, P.P.Craig,
Nagle, D.R.F.Cochran and W.E.Keller.
. Rev. Letters, Vol. 5, No. 4, 152-4 (Aug. 15, 1960).
The effect on the intensity of the Mössbauer absorption pattern
temperature difference between source and absorber was in-
igated. The results showed qualitative agreement with theory
demonstrated that the hyperfine field in Co^{57} is parallel to that
e, i.e., opposite to the ferromagnetic domain magnetization.

E.A.Sanderson

539.14 : 539.17

EXCITED STATES OF B^{11}. See Abstr. 17597

539.14 : 539.16

DECAY MODES OF THE EXCITED STATE IN N^{14}. See
tr. 17562

539.14

7490 TABLES OF ROTATIONAL ENERGY LEVELS OF DEFORMED EVEN—EVEN NUCLEI.
.Moore and W.White.
ad. J. Phys., Vol. 38, No. 9, 1149-53 (Sept., 1960).
A digital computer has been used to extend calculations of
tional energy levels of deformed even—even nuclei treated in
manner of Davydov and Filippov. Tables are presented which
be useful for comparison with experimental energy levels of
spin such as realized in Coulomb excitations by heavy ions.

539.14

17491 ENERGY LEVELS IN A BOUNDED ISOTROPIC HARMONIC OSCILLATOR POTENTIAL AND NUCLEAR
LL STRUCTURE. S.Sengupta and S.Ghosh.
an J. theor. Phys., Vol. 6, No. 1, 1-21 (March, 1958).
Quantum mechanical problem of a nucleon moving within an
ropic harmonic oscillator potential of value $V = \frac{1}{2}kr^2$, and
losed within a spherical box with rigid walls (infinite potential
l) is investigated. Approximate expressions for energy levels
obtained. These levels are essentially determined by the para-
ter

$$\rho = \frac{\hbar\omega}{\hbar^2/MR^2} \text{ where } \omega = \sqrt{\frac{k}{M}}$$

he classical circular frequency of the oscillator and R is the
ius of the box. For small ρ energy levels tend to those of infinite
ential well and for large ρ they tend to the energy levels of an
ounded oscillator. Introducing a spin orbit coupling term 30 times
Thomas value and for $\rho = 6$ and $R = 1.3 \times 10^{-13} A^{1/3}$ excellent
eement with experimental shell structure is obtained. Level
emes are in close agreement with the observed ones.

539.14

17492 s-PARTICLE DOUBLETS IN CERTAIN LIGHT NUCLEI. O.M.Bilaniuk and J.B.French.
clear Phys., Vol. 17, No. 3, 435-47 (July (1), 1960).
The splitting of an s-particle doublet in B^{11} is examined to see
at information it gives about the effective 1p—2s shell-model
eraction and it is concluded that the small splitting is explainable
an interaction whose spin dependence is primarily of $s_1 \cdot s_2 t_1 \cdot t_2$
ure. Certain other s-doublets of the "hole-particle" type are
sidered too and their small splitting appears to show that the spin-dependence of the effective n—p interaction between inequivalent nucleons is weaker than normally assumed. A very simple procedure is used to evaluate the interaction energies.

539.14

17493 LOCATION OF THE $3s_{1/2}$ SINGLE PARTICLE NEUTRON LEVEL IN VARIOUS NUCLEI. B.L.Cohen and R.E.Price.
Nuclear. Phys., Vol. 17, No. 1, 129-40 (June (2), 1960).

The $3s_{1/2}$ neutron levels in nuclei of mass 85-135 are located by angular distributions of protons from (d, p) reactions on nuclei with even neutron numbers. Where the proton number is even, almost all of the single-particle level is in one nuclear level, and where there is an odd proton of low j, it is in two levels with spin $j + \frac{1}{2}$ and $j - \frac{1}{2}$ which are separated by about 60 keV. Both of these cases are in agreement with the simple single-particle model with negligible configuration mixing, but where there is an odd proton of large j, the single-particle level has many components, indicating strong configuration mixing. The binding energy of the $3s_{1/2}$ neutron varies very smoothly from isotope to isotope of the same element, and when corrected for symmetry energy, its variation with A is very smooth. The variation with A decreases by about half when its major shell begins filling, and becomes negligible when ground states of odd-mass nuclei are $s_{1/2}$. This is explained as due to the fact that the levels become partially "hole" states, and since the energy of particle and hole states shift in opposite directions as a function of mass number, the two effects tend to cancel. Since, according to pairing theory and experimental observations, all subshells in a major shell begin to fill when the major shell begins to fill, energy shifting of a single-particle level decreases rapidly one its major shell begins to fill. The observed shifting is in at least semi-quantitative agreement with the theory. Some difficulties with the Wilkinson (1956) theory of the photonuclear giant resonance are pointed out, and strong evidence against reduced mass effects in excited states of nuclei are presented.

539.14

17494 NEUTRON ENERGY LEVELS IN A DIFFUSE POTENTIAL. A.Ghoshi and N.C.Sil.
Nuclear Phys., Vol. 17, No. 2,264-70 (June (3), 1960).

The energy eigenvalues of neutrons within the nucleus for a spherically symmetrical potential $V(r) = -V_0[1 + \exp\{(r-R)/a\}]^{-1}$ were investigated by following a method due to Lanczos (1938) for solving the differential equation. The s- and p-state energy levels were calculated for atomic mass 200 with the values of parameters adopted by Feshbach, Porter and Weisskopf in their calculation of the neutron strength function with a similar potential. The results of the present calculation agree closely with those of Malenka (1952), whose potential is nearly, though not exactly, the same as used here.

539.14 : 539.17

INDIVIDUAL STATES AT THE FISSION THRESHOLD.
See Abstr. 17630

539.14 : 539.17

PARAMETERS OF THE 7.66 MeV STATE OF C^{12}. See
Abstr. 17609

539.14

17495 THE FIRST T = 1 LEVEL IN ^{18}F. A.A.Jaffe, I.J.Taylor and P.D.Forsyth.
Proc. Phys. Soc., Vol. 75, Pt 6, 940-1 (June, 1960).

The angular distribution of the protons leading to the ground state in the reaction O^{16} (t,p) O^{18} has been measured. The distribution is very similar to that observed by Hinds and Middleton (Abstr. 7304 of 1959) for the protons leading to the 1.044 MeV state in the reaction $O^{16}(He^3,p)F^{18}$. It is suggested that this removes any doubt that the first T = 1 level of F^{18} is that at 1.044 MeV.

L.L.Green

539.14

17496 ENERGY LEVELS OF He^5 AND Li^5. L.D.Pearlstein, Y.C.Tang and K.Wildermuth.
Phys. Rev., Vol. 120, No. 1, 224-34 (Oct. 1, 1960).

The energies of the first three levels in He^5 are determined using a variational procedure. The various wave-functions adopted incorporate alpha, triton, and deuteron correlations. It is determined that the ground state ($\frac{3}{2}-$) must be an alpha—neutron configuration whereas the ($\frac{1}{2}-$) level, which must also be described by this configuration, is not a sharp resonant state. The ($\frac{3}{2}+$) level at 16.69 MeV is shown to be a deuteron—triton configuration. The resultant energies and structures of these levels are in accord with the experimental situation. It is stressed that these wave-functions differ appreciably from the standard shell-model ones in the intermediate-coupling picture.

539.14

17497 LOW LYING LEVELS OF Li^7 AND Be^8 IN THE CLUSTER MODEL.
L.D.Pearlstein, Y.C.Tang and K.Wildermuth.
Nuclear Phys., Vol. 18, No. 1, 23-39 (Aug. (1), 1960).

A study of the first few levels of Li^7 and Be^8 was carried out. To calculate the appropriate energies, a variational procedure was adopted in which some of the long-range nuclear correlations were incorporated in the wave-function wherein they appear as favoured cluster configurations, i.e. alpha, triton groups. Agreement with experiment was obtained for the three rotational levels of Be^8 and the two rotational levels of Le^7. For the first change of parity level in the latter nucleus, however, arguments are presented indicating that the inclusion of a deuteron substructure would reproduce the properties of this level.

539.14 : 539.17

WIDTHS OF THE 10.15 MeV LEVEL IN Mg AND THE 11.40 MeV LEVEL IN Si. See Abstr. 17621

539.14

17498 THEORETICAL APPROACH TO THE LOW-ENERGY SPECTRUM OF Mo^{93}. M.Bouten.
Nuclear Phys., Vol. 17, No. 4, 695-8 (July (2), 1960).

The levels of Mo^{93} are calculated by considering three nucleons outside a spherical core. The interaction potential is taken to be of zero range. The level ordering is in good agreement with the experimental low-energy spectrum. The question whether Mo^{83} has spin $\frac{21}{2}$ or $\frac{23}{2}$ seems to be settled in favour of the first value.

539.14 : 539.17

17499 LEVEL STRUCTURE OF N^{14}.
J.K.Bair, H.O.Cohn and H.B.Willard.
Phys. Rev., Vol. 119, No. 6, 2026-9 (Sept. 15, 1960).

Yields and angular distributions of the gamma rays from the first and second levels in C^{13} following excitation by inelastic proton scattering were measured. Levels were observed at bombarding proton energies 3.80 MeV (Γ = 100 keV), 4.1 MeV (Γ = 150 keV), 4.14 MeV and 4.52 MeV (Γ = 150 keV). The first three levels result in excitation of the first excited state and the last in excitation mainly of the second excited state of C^{13}. N^{14} excitation energies corresponding to these levels are 11.07, 11.3$_5$, 11.39, and 11.74 MeV. Possible spin and parity assignments are made on the basis of the γ-ray angular distribution of the 4.52 MeV level. The C^{13}(p,n)N^{13} neutron yield was re-examined yielding better values of the resonant energies. Neutron angular distributions are given for several bombarding proton energies.

539.14

17500 SHELL MODEL AND Pb^{208}.
J.C.Carter, W.T.Pinkston and W.W.True.
Phys. Rev., Vol. 120, No. 2, 504-12 (Oct. 15, 1960).

The lowest odd-parity excited energy levels of Pb^{208} have been calculated by a shell-model approach considering a single proton or a single neutron to be excited out of the Pb^{208} core. Both a singlet-even plus triplet-even force and a Rosenfeld force were used as the two-particle interaction. A zero-range force was also considered. There were no other arbitrary parameters. The results with the various forces indicate that it is impossible to get a 3− state low enough to be interpreted as the observed 2.615 MeV 3− level. The results, therefore, support the conclusion that the 3− level at 2.615 MeV in Pb^{208} is primarily the result of a collective octupole oscillation.

539.14

17501 LEVEL SCHEME OF Pr^{144}. A.K.Sengupta, R.Bhattacharyya, J.Lahiri and P.N.Mukherjee.
Indian J. Phys., Vol. 33, No. 9, 388-94 (Sept., 1959).

The level scheme of Pr^{144} following β-decay of Ce^{144} has been studied with a Siegbahn—Slätis β-ray spectrometer and scintillation spectrometers. Three β-groups have been observed with end-point energies and relative intensities as 184 keV (26%), 240 keV (8%) and 312 keV (66%). Corresponding gamma-rays of energies 53 KeV, 81 keV and 134 keV have also been detected. Internal conversion lines of these transitions along with those of some other γ-lines of energies 33 keV, 38 keV, 42 keV, 59 keV and 95 keV have been observed K/L ratio and half-time measurement of the 134 ke
γ-line indicate an M1 multipolarity for this transition. Coincid
studies have also been made and a tentative decay scheme is pr

53

17502 PARITY CONSERVATION OF THE NUCLEAR STAT
IN Rb^{85}. T.Mayer-Kuckuk and S.A.A.Zaidi.
Z. Phys., Vol. 159, No. 4, 369-72 (1960). In German.

Nuclear γ-radiation must be circularly polarized if parity
servation does not hold strictly in nuclear states. From a pola
tion measurement of the 513 keV γ-line in Rb^{85} an upper limit f
relative amplitude of the irregular wave-function F ≤ 5.5 × 10
obtained.

5

17503 ENERGY LEVELS OF Si^{29}, Si^{30} AND Si^{31} FROM (d,
REACTIONS. C.P.Browne and J.T.Radzyminski.
Nuclear Phys., Vol. 19, No. 2, 164-72 (Oct. (1), 1960).

The Si^{28}(d, p)Si^{29} reaction was used to locate nuclear energ
levels in Si^{29} in the range of excitation energy between 3.5 and
9.1 MeV. The bombarding energy was 7.03 MeV and the M.I.T.
broadrange spectrograph was used to resolve the particle grou
Identification was based on a change of observation angle and a
change of isotopic abundance in the target. A total of 65 levels
Si^{29} was found in the range covered, 54 of which have not been r
ported before. In addition, 16 particle groups were assigned to t
reaction Si^{29}(d, p)Si^{30} and 7 groups to the reaction Si^{30}(d, p)Si^{31}.
The Si^{30} levels lie in the range of excitation of 6.4 to 10.8 MeV
and have not been reported before, whereas the Si^{31} levels lie
between 2.3 and 5.5 MeV and two of these are new. Q-values an
excitation energies are listed for all these groups. The uncerta
in Q-value for most of the levels is ±5 keV.

539.14 : 53

17504 A STUDY OF ENERGY LEVELS IN Sc^{43}, Ti^{45}, V^{47}, V
V^{50} AND Zn^{65}.
G.J.McCallum, A.T.G.Ferguson and G.S.Mani.
Nuclear Phys., Vol. 17, No. 1, 116-28 (June (2), 1960).

Thresholds for neutron emission following the proton bom-
bardment of Ca^{43}, Ca^{44}, Sc^{45}, Ti^{47}, Ti^{49}, Ti^{50} and Cu^{65} were studi
up to a proton energy of 4.9 MeV. The positions of excited stat
in Sc^{43}, Ti^{45}, V^{47}, V^{49}, V^{50} and Zn^{65} have been determined.

539.14 : 53

17505 ENERGY LEVELS IN ^{28}Si FROM THE ^{27}Al(p, γ) ^{28}Si
REACTION. P.M.Endt and A.Heyligers.
Physica, Vol. 26, No. 4, 230-54 (April, 1960).

The gamma-ray spectra from twelve Al^{27}(p, γ) Si^{28} resonan
in the E_p = 500 to 800 keV region were investigated with scintill
spectrometers. Both single and coincidence spectra were mea
from which the branchings were obtained in the decay of the
resonance levels and of lower levels at 1.783 ± 0.008, 4.623 ± 0
6.28 ± 0.02, 6.88 ± 0.05, 7.37 ± 0.02, 7.42 ± 0.02, 7.93 ± 0.03,
8.32 ± 0.05, 8.41 ± 0.05, 8.59 ± 0.03, 8.92 ± 0.02, 9.31 ± 0.02,
9.38 ± 0.02, 9.49 ± 0.02, 9.76 ± 0.02 and 10.71 ± 0.02 MeV. The
levels at 9.31, 9.38 and 10.71 MeV very probably have T = 1
character. They would correspond to the ground-state, the 0.03
and the 1.37 MeV levels in Al^{28} with $J^{\pi} = 3^+$, 2^+ and 1^+, respecti
From yield measurements the resonance strengths
$\omega\gamma = (2J + 1)\Gamma p\,\Gamma\gamma/\Gamma t$ were obtained for all resonance levels.

539.14 : 5

ENERGY LEVELS OF Ti^{47,49}. See Abstr. 17605

53

17506 A MODEL FOR HYPERFRAGMENTS.
E.C.G.Sudarshan and S.Iwao.
Proc. Indian Acad. Sci. A, Vol. 52, No. 1, 27-34 (July, 1960).

A somewhat unconventional application of the ideas of the s
model of nuclei to very light hyperfragments. The authors clai
deduce, amongst other things, that the spin of $_{\Lambda}$He^4 is zero.

S.J.Gold

53

17507 A THEORY OF HYPERFRAGMENTS. I. BINDING
ENERGIES AND LEVEL STRUCTURE. S.Iwao.
Nuovo Cimento, Vol. 17, No. 4, 491-515 (Aug. 16, 1960).

A model for the structure of hyperfragments is developed w
is similar to the shell model for ordinary nuclei. The projectio
theorem relations for s and p shell hyperfragments are worked
and the case of two-particle interactions is dealt with in detail.

interaction parameters for s and p shell hyperfragments are ced by a fit with the experimental data and the goodness of fit eved on the model is satisfactory. An interesting inference is $_{\Lambda}He^4$ has zero spin and hence the kaon is pseudoscalar. A t of the hyperfragments including energy levels, stability and ible spins is presented. As a further application of the pro- on theorem an expression is derived for the magnetic moments rious hypernuclei. The present model is compared with ious work and some comments on the plausibility of the model nade.

539.14

7508

ON MESONIC DECAYS OF THE HYPERNUCLEUS $^3H_{\Lambda}$. D.Ivanenko and V.Lulka.

vo Cimento, Vol. 16, No. 3, 582-4 (May 1, 1960).

It is shown that by taking into account the final state interaction, obtains better agreement with experiment for the calculated o of the decay rates of the two channels, $^3H_{\Lambda} \rightarrow {}^3He + \pi^-$ and $\rightarrow d + p + \pi^-$, thereby strengthening the conviction that $_{\Lambda}H^3$ has in value $\frac{1}{2}$. E.A.Sanderson

539.14

7509

NON-SPONTANEOUS DISINTEGRATION OF HYPERNUCLEI IN FLIGHT. H.Neumann and H.S.Valk.

vo Cimento, Vol. 17, No. 3, 415-22 (Aug. 1, 1960).

On the basis of a binary model, expressions are obtained for probability of hypernuclear disintegration in flight. Numerical ulations for 50 MeV $_{\Lambda}He^5$ slowing in liquid hydrogen, oxygen, xenon indicate that such processes are most prevalent for lium-Z media. Of the two processes considered, stripping and tric dissociation, the former appears to dominate in the medium- large-Z range.

539.14

17510

BRANCHING RATIOS FOR THE DECAY OF p-SHELL Λ-HYPERNUCLEI. R.D.Lawson and M.Rotenberg.

vo Cimento, Vol. 17, No. 4, 449-61 (Aug. 16, 1960).

The possibility of determining the spin dependence of the ucleon force from a study of hypernuclei in which the Λ particle ound to a nucleus with an incompletely filled (1p) nuclear shell nvestigated. It is pointed out that present uncertainties in the on binding energies of hypernuclei permit only the determina- of the combination $E_s + 3E_t$, where E_s and E_t are the singlet triplet interaction energies, respectively. It is shown that the ay of hypernuclei by π^- emission can give information regarding spin dependence of the force if the branching ratio for decay to ground state and first excited state of the daughter nucleus is asured. In particular, if the spin of $_{\Lambda}B^{12}$ is 2, decay to the first ited state of C^{12} is favoured by a factor 1.2 over decay to the und level. However, if J = 1 for this hypernucleus, decay to the und state is preferred by a factor of 2.4. The change that the raction of the π^--meson with the C^{12} nucleus produces in the nching ratio is estimated by use of a complex square well ential. Inclusion of the interaction significantly increases the nching ratio for a hypernuclear spin of 2, but does not change the o for J = 1. On the other hand, for $_{\Lambda}Li^7$ the branching ratio for ay to the ground and first excited state of Be^7 is independent of spin of hypernucleus.

539.14

17511

THE QUESTION OF THE EXISTENCE OF $(\Lambda^0 P)$, $(\Sigma^+ P)$ AND $(\Sigma^- n)$ HYPERFRAGMENTS. R.C.Kumar.

ian J. Phys., Vol. 33, No. 10, 411-14 (Oct., 1959).

RADIOACTIVITY . NUCLEAR DECAY

539.16 : 539.17

17512

HEAVY ISOTOPE ABUNDANCES IN MIKE THERMONUCLEAR DEVICE. H.Diamond, P.R.Fields,

.Stevens, M.H.Studier, S.M.Fried, M.G.Inghram, D.C.Hess, .Pyle, J.F.Mech, W.M.Manning, A.Ghiorso, S.G.Thompson, .Higgins, G.T.Seaborg, C.I.Browne, H.L.Smith and R.W.Spence.

ys. Rev., Vol. 119, No. 6, 2000-4 (Sept. 15, 1960).

The November 1, 1952 thermonuclear explosion ("Mike") pro- ced all of the uranium isotopes U^{239}, U^{240}, ...U^{255} through multiple neutron capture by U^{238}. The long-lived products of successive β-decays from these isotopes were measured mass spectrometrically and radiometrically. The logarithms of the abundances decline smoothly with increasing mass number; the even-mass abundances slightly exceed the geometric mean of adjacent odd-mass abundances. Some nuclear properties of neutron-rich heavy nuclides, not subject to ordinary investigation, are inferred.

539.16 : 551.5

17513

γ-RAY SPECTROSCOPY OF ARTIFICIAL RADIOACTIVE SAMPLES FROM ATMOSPHERIC AIR.

F.Demichelis and G.Lovera.

Nuovo Cimento, Vol. 15, No. 6, 970-8 (March 16, 1960).

Samples of active matter were obtained on different dates between October, 1958 and June, 1959, by filtration of atmospheric air at ground level in Naples. Using an NaI(Tl) scintillation spectrometer, the γ-radiation was analysed in detail and the relative intensities due to various known artificial radionuclides determined. It is shown that such a study can yield data on atmospheric exchanges between stratosphere and troposphere as well as information on atmospheric circulation in general. R.E.Meads

539.16

17514

AN APPARATUS FOR THE VACUUM DEPOSITION OF RADIO ACTIVE MATERIALS. W.Parker.

Nuclear Instrum. and Methods, Vol. 5, No. 3, 142-7 (Sept., 1959).

An apparatus is described for the preparation of radioactive sources by means of vacuum deposition for use in nuclear spectroscopy. The collimated crucibles described allow for smaller amounts of active material to be used in the preparation because of the higher yield obtained. Also the risk of contamination to the vacuum system is greatly reduced. Special attention is paid to the preparation of sources of the point and the strip variety. Total yields obtained from the evaporations, and curves showing the distribution of active deposits, together with a list of sources so far prepared in this manner are given.

539.16

17515

ALL-TEFLON COUNTING CELL FOR FLOWING RADIOACTIVE SOLUTIONS. W.J.Blaedel and E.D.Olsen.

Analyt. Chem., Vol. 32, No. 7, 789-91 (June, 1960).

An all-Teflon counting cell was constructed for continuous monitoring of small radioactive effluent streams. The bonding procedure permits a very thin film of Teflon to be firmly fastened to a Teflon cell block, and enables solution counting of even as weak a beta-emitter as Ca^{45}. Entrapment of air, holdup, and mixing are minimized. A few elements are adsorbed very strongly by Teflon and the last traces are not removed even by extended washing.

539.16 : 539.23

17516

PREPARATION OF THIN BETA-RAY SOURCES BY EVAPORATION AND CATHODE SPUTTERING.

T.M.Novakov and M.S.Mladjenovic.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 69-73 (March, 1956).

A description is given of a new method of preparation of thin β-ray sources, based on cathode sputtering. The results for Ir and Eu are given. A graphite oven, convenient for the thermal evaporation at high temperature, is also described.

539.16

17517

INSTRUMENT FOR ELECTRON-GAMMA DIRECTIONAL CORRELATION EXPERIMENTS WITH MAGNETIC MOMENTUM SELECTION. T.R.Gerholm and B.G.Pettersson.

Nuclear Instrum and Methods, Vol. 4, No. 2, 107-11 (March, 1959).

A medium thick lens spectrometer was adapted for electron-gamma angular correlation experiments. The requirements to be fulfilled are discussed. It was found that the necessary mutual independence between spectrometer and gamma-counter can be obtained by suitable iron and mu-metal shielding. A transmission of 1.5% at 3% resolution has been obtained, when utilizing a mean emission a angle of 12.5°.

539.16 : 539.1.07

SCINTILLATION SPECTROMETER WITH CONSTANT RELATIVE CHANNEL WIDTH. See Abstr. 17280

539.16

17518

THE HIGH-FREQUENCY DEFLECTION METHOD FOR MEASURING SHORT HALF-LIVES. I. PRINCIPLE AND SOME MEASUREMENTS. B.Johansson and T.Alväger.

Ark. Fys., Vol. 17, Paper 10, 163-76 (1960).

Some investigations of the high-frequency deflection method for measuring short half-lives have been made. The method has shown to be useful for measuring the half-lives of moderately converted γ-transitions below 1 MeV fed by converted γ-transitions, β-radiation or possibly also α-radiation. Half-lives in the range 10^{-10} –10^{-13} sec should be measurable from the slope of the resolution curve. With a frequency of 146 Mc/s, a resolving time of 3×10^{-10} sec has been obtained for the test arrangement for 300 keV conversion electrons. The slope of the resolution curve corresponds to a half-life of 3×10^{-11} sec. Some preliminary measurements with the following results have been performed. For the 279 keV level in Tl^{203}, $T_{1/2} = (2.2 \pm 0.3) \times 10^{-10}$ sec; 313 keV level in U^{233}, $T_{1/2} = (2.0 \pm 0.3) \times 10^{-10}$ sec; 2385 keV level in Pb^{206}, $T_{1/2} \leq 3 \times 10^{-11}$ sec; 239 keV level in Bi^{212}, $T_{1/2} \leq 8 \times 10^{-11}$ sec.

539.16

17519 THE LIFETIME OF THE FIRST EXCITED STATE OF Mg^{25} AND THE COLLECTIVE MODEL.

G.R.Bishop and P.Kossanyi-Demay.

J. Phys. Radium, Vol. 20, No. 12, 921-6 (Dec., 1959). In French.

The lifetime was determined by measuring the distance that the recoiling nucleus travelled from the reaction $Mg^{25}(p,p')Mg^{25*}$. The lifetime was found to be in the range $(2 < \tau < 4) \times 10^{-9}$ secs. This is compared with the predictions of the collective model, using wave-functions obtained by a modification of Nilsson's calculations for the d-shell.

539.16

17520 CALORIMETRIC MEASUREMENT OF THE HALF-LIFE OF Y^{90}. J.Robert.

J. Phys. Radium, Vol. 20, No. 10, 830-1 (Oct., 1959). In French.

The half-life was measured in an adiabatic microcalorimeter with automatic temperature compensation. The material was in the form of the oxide Y_2O_3 irradiated in a pile. The half-life was 64.3 ± 0.4 hr in good agreement with previous results obtained by entirely different methods. A.E.I. Research Laboratory

539.16

17521 ON THE $^{196}Au^{m}$ ISOMERIC STATE.

M.Ademollo, M.Bocciolini, G.D.Caporiacco and M.Mandò.

Nuovo Cimento, Vol. 16, No. 2, 378-81 (April 16, 1960).

Reports measurements on the Au^{196m} isomeric state which largely agree with previously published results of Van Lieshoutetol. Branching ratios of the production of the state by (γ,n) and $(n,2n)$ processes are found to be $< 10^{-2}$ and $(5 \pm 1) \times 10^{-3}$ for 14.5 MeV neutrons. A gamma-ray spectrum showed peaks at 149 ± 2 keV and the half-life of the state was measured as 9.8 ± 0.3 hr. Coincidence measurements suggest that the 149 keV line could have a structure. R.H.Thomas

539.16

17522 TWO-QUANTA TRANSITIONS IN Ba^{137}.

W.Beusch.

Helv. phys. Acta, Vol. 33, No. 5, 363-94 (1960). In German.

According to second-order perturbation theory, transitions in nuclear isomers should occur for which two quanta are emitted with arbitrarily divided energies. The transition probability for such a process has been calculated for Ba^{137m} for various multipole transition combinations. The dependence of transition probability upon energy for electric multipole transitions differs from that for magnetic. Experimental coincidence measurements have been undertaken using high time resolution and two-dimensional pulse analysis. Corrections were determined for random coincidences and for contamination activity. The probability for emission of two bremsstrahlung quanta was calculated; it was found to be negligibly small. The measured ratio of transition probabilities for first- and for second-order processes was

$$T^{(2)} : T^{(1)} = (6.4 \pm 3.1) \times 10^{-6}.$$

This value is approximately 10 times smaller than that expected from a theoretical estimate.

539.16

17523 PRODUCTION OF SHORT LIVED ISOMERS BY PULSE ACTIVATION WITH THERMAL NEUTRONS.

K.F.Alexander and V.Bredel.

Nuclear Phys., Vol. 17, No. 1, 153-62 (June (2), 1960). In German.

An external neutron beam from the Rossendorf Research Reactor was periodically interrupted by a steel rotor. By placing a sample in the modulated neutron beam it was possible to observe short-lived isomeric states produced by thermal-neutron captur
The spectra of the delayed γ-radiation were measured with a scintillation spectrometer. In this way a number of isomeric transitions were found and their half-lives were obtained by mea
of a five-channel time analyser. The energies and half-lives of the following isomers were measured: Na^{24m}(475 ± 10 keV, 20 ± 1 msec); Ga^{m} (99 ± 5 keV, 38 ± 1 msec); In^{116m} (160 ± 8 keV
2460 ± 80 msec); Ho^{166m} (131 ± 5 keV, 0.214 ± 0.010 msec). The newly discovered Ho^{166m} had K-conversion coefficient of about
therefore the transition is probably of the type E2.

53

17524 THE ISOMERIC ATOMIC NUCLEI Yb^{169m}, Yb^{175m}, Yb^{1}

K.W.Hoffmann, I.Y.Krause, W.D.Schmidt-Ott and A.Flammersfeld.

Z. Phys., Vol. 160, No. 2, 201-12 (1960). In German.

Short lived isomers of Yb were produced by neutron irradia
of enriched isotopes and have been investigated with the aid of scintillation spectrometers. Yb^{169m} decays with a half-life of $T_{1/2} = (46 \pm 2)$ sec emitting only L-radiation. This decay is assu
to be the same as the E3-transition of 24 keV following the elect
capture of Lu^{169}. Yb^{175m} $[T_{1/2} = (0.072 \pm 0.005)$ sec$]$ emits γ-rays
(495 ± 15) keV. The measured K-conversion coefficient $\alpha_{K_{495}} = 0.24 \pm 0.04$ and the total conversion coefficient $\alpha_{495} = 0.6 \pm 0.3$ indicate the transition to be M3. Yb^{177m} $[T_{1/2} = (6.4 \pm 0.1)$ sec$]$ decays by a cascade of two γ-rays. The isomeric (228 ± 3) keV-transition is followed by a (104 ± 1.5) ke
radiation. The measured conversion coefficients are $\alpha_{K_{228}} = 4.1 \pm 0.4$ and $\alpha_{228} = 6.5 \pm 0.5$ for the first transition and $\alpha_{K_{104}} = 0.39 \pm 0.05$ and $\alpha_{104} = 0.51 \pm 0.05$ for the second, indicati
a M3—E1 cascade. For the M3 transition the measured coefficie
agree well with those calculated for a nucleus of finite size, but t
differ by a factor of 1.5 for the E1 transition.

53

17525 DETERMINATION OF THE ALPHA PARTICLE ENE FROM RADIUM-223 AND ITS DECAY PRODUCTS.

A.Rytz.

C.R. Acad. Sci. (Paris), Vol. 251, No. 1, 68-9 (July 4, 1960). In French.

Describes the results obtained for the energies of the alpha particles emitted by Ra^{223}, Rn^{219} and Po^{215}. This work follows th
described in a previous paper (Abstr. 13183 of 1960). The energ
measured are higher than those reported earlier. Excellent agr
ment is obtained in measurements of the energy of the gamma-ra
emitted. R.H.Tho

53

17526 HALF-PERIOD OF Th^{232}.

T.A.Farley.

Canad. J. Phys., Vol. 38, No. 8, 1059-68 (Aug., 1960).

A redetermination of the half-period of Th^{232} by ion chambe
alpha particle spectroscopy has been made. It was originally undertaken to check the possibility that an error in the half-peri
of Th^{232} is responsible for discrepancies in geological ages of rocks determined from Th/Pb ratios as compared with ages dete
mined from U/Pb ratios. A gridded, pressurized, 2π geometry
chamber using an argon—methane counting gas was used as a detector for alpha particles emitted from thin layers of metallic thorium evaporated onto glass plates. The counting rate under t
Th^{232} alpha peak was measured with a 256 channel pulse height analyzer, and corrections of about 1% were made for self-absorp
tion and backscatter by the glass plate and counting gas. The samples were chemically analysed for thorium content by a spec
trophotometric method. The average half-period for 12 samples
$T_{1/2} = 1.41 \times 10^{10}$ years, with a standard error of 1%. The result
in substantial agreement with the half-periods of greater uncerta
already reported in the literature, and geological age discrepanc
cannot be attributed to error in the half-period of Th^{232}.

53

17527 ON FERMI THEORY AND SARGENT RULE FOR β-DECAY. S.Purkayastha.

Indian J. theor. Phys., Vol. 6, No. 1, 23-34 (March, 1958).

In this paper Sargent's rule (1933) has been studied from the standpoint of Fermi's theory. A number of theoretical Sargent curves has been drawn with different constants according to Fer
formula. The experimental points are found to lie on these curv
even in the bent portion at low energy region irrespective of the atomic number Z and ΔI.

539.16 : 539.11

FOUR-FERMION COUPLING IN BETA-DECAY. See
r. 17232

539.16

ON THE PROCESS OF β-EMISSION.

7528 K.C.Kar.

n J. theor. Phys., Vol. 5, No. 4, 111-12 (Dec., 1957).
A note on the origin of the electron produced.

539.16

STUDY OF EMISSION OF LIGHT POSITIVE PARTICLES FROM NEGATIVE BETA EMITTERS.

17529 A.B.Milojević.

. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 21-34 (March, 1956).
For this purpose a method was developed using a small spectro-
er for injecting the particles of a given sign in a magnetic Wilson
d chamber. This method allows the discrimination of the sign
article tracks in the cloud chamber by a factor of 10^{-2}. At the
e time, an analysis of electromagnetic radiations from a radio-
ve phosphorus sample, prepared by the reaction S(n,p)P, was
ormed with a scintillation gamma-spectrometer, and the rate of
tron production discussed. The results obtained were in agree-
t with the theoretical predictions for the internal bremsstrahlung
for the internal pair creation by the emitted negative beta-rays.
nvestigating the emission of light positive particles from radio-
ve P^{32}, it was found that the ratio of positive particles, emitted
n the source, per negative beta disintegration, is less than
10^{-6}.

539.16

THE ELECTRIC QUADRUPOLE INTERACTION IN BETA DECAY.

17530 J.M.Pearson and M.A.Preston.

lear Phys., Vol. 18, No. 1, 91-109 (Aug. (1), 1960).
In the β-decay of strongly deformed nuclei the electrostatic
d in which the decay electron moves by no means possesses the
erical symmetry that it has been customary to assume in β-decay
ry. The angular momentum of the electron will not be con-
ved and different, closely lying, rotational states of the daughter
leus will be coupled together. The possibility is considered
it is this electric quadrupole coupling, rather than a failure
ure rotational structure, that is responsible for the observed
malies in the branching ratios of the first forbidden decays of
^{76}, Ta^{180} and Np^{236}. The general theory of the β-decay of strongly
ormed nuclei is set up, taking into account the electric quadrupole
pling, and is specialized to the case of first forbidden decays of
n nuclei. The electron functions are obtained by an essentially
ct method, the Dirac equation appropriate to a non-central inter-
ion being solved numerically on a computer. It is found that the
pling effect on the branching ratio can be no larger than 4% or
which is far too small to account for the observed values.

539.16

EVIDENCE FOR 0^+ AND 1^- LEVELS IN U^{234} POPULATED IN THE ONE-MINUTE BETA DECAY OF Pa^{234}.

17531

.Wood.
ys. Rev., Vol. 119, No. 6, 2004-9 (Sept. 15, 1960).
A directional correlation measurement was performed on the
keV versus (751 + 795) keV composite cascade in U^{234} following
24 day beta decay of Th^{234} and the subsequent 1 min beta decay
Pa^{234}. The "770" keV (751 + 795 keV) composite photopeak
ctrum coincident with the 250 keV gamma ray was displayed on a
ltichannel pulse-height analyser for different positions of the
ntillation counters. From these spectra the directional correla-
ns between the 250 keV gamma ray and the lower and upper sides
the 770 keV composite line were measured. The results together
h other measurements are consistent with assignments of multi-
arity E1 to the 250, 751 and 795 keV gamma rays and spin and
ity assignments $0^+ - 1^- - 2^+$ and $0^+ - 1^- - 0^+$ to the levels
olved in the 250-751 keV and 250-795 keV gamma—gamma cas-
les, respectively. Thus new levels are proposed at 795 and
16 keV with spin and parity 1^- and 0^+, respectively.

539.16

DECAY OF Pm^{149} (53 hr).

17532 L.C.Schmid and S.B.Burson.

ys. Rev., Vol. 120, No. 1, 158-61 (Oct. 1, 1960).
The radioactive sources were obtained from neodymium oxide,
riched in Nd^{148}, irradiated in the Argonne reactor CP-5. After
1.8 hr activity of Nd^{149} had decayed away, the 53 hr activity in
n^{149} remained. Some of the samples were purified by ion-exchange-column techniques before being studied. The radiations were investigated with a 180° focusing beta-ray spectrometer and the Argonne 256-channel scintillation coincidence spectrometer. The magnetic spectrometer resolved two components of the beta spectrum at 1.064 ± 0.008 and 0.784 ± 0.010 MeV. The beta rays were also studied by coincidence absorption techniques. In addition to the branch with a maximum energy of 0.784 ± 0.010 MeV, this method revealed two more at 0.47 ± 0.04 and 0.19 ± 0.04 MeV. The scintillation pulse-height spectrum of the gamma rays revealed the presence of three transitions at 0.850 ± 0.008, 0.582 ± 0.006, and 0.285 ± 0.001 MeV. A fourth gamma ray with an energy of 0.548 ± 0.006 MeV was found in coincidence measurements. These radiations are fitted into a decay scheme comprising the ground state and four excited states in Sm^{149} at 0.285, 0.582, 0.833, and 0.850 MeV. The log ft values, transition intensities, and possible spin and parity assignments are discussed.

539.16

BETA-DECAY OF Sr^{89}.

17533 C.Manduchi and M.T.Russo-Manduchi.

Nuovo Cimento, Vol. 17, No. 4, 516-22 (Aug. 16, 1960). In Italian.

An experiment for the determination of the specific shape of the interaction which controls the β-decay of Sr^{89}, whose spectrum is "unique first forbidden", is described. The results, obtained using electron—neutrino angular correlation measurements, show that the prevailing interaction is of the "axial vector" kind, without excluding, however, a possible contribution from the interaction of "tensor" kind not greater than 26%.

539.16

β-SPECTRUM OF Tl^{204}.

17534 K.Egelkraut and H.Leutz.

Z.Phys., Vol. 160, No. 1, 74-9 (1960). In German.

The spectrum was measured with Tl^{204} impregnated NaI:Tl crystals. The maximum β-energy was found to be 761 ± 8 keV. The measured deviations from the statistical shape correspond with the theoretical shape factor for first unique forbidden transitions. A β-transition into the 375 keV level of Pb^{204} could not be found.

539.16

THE HALF-LIVES OF SOME POSITRON EMITTERS WITH SUPERALLOWED TRANSITIONS.

17535 J.Jänecke.

Z. Naturforsch., Vol. 15a, No. 7, 593-600 (July, 1960). In German.

The half-lives of 15 superallowed β^+-emitters were measured with high accuracy. There are deviations from the known values, especially for Sc^{41}. A plot of log $T_{1/2}$ versus $(\overline{Z}/A^{1/3})$ for the mirror transitions and the $0^+ \rightarrow 0^+$ transitions of the nuclei with A = 4n + 2 contains breaks and irregularities, and therefore shows the effect of shell structure.

539.16

DOUBLE BETA DECAY. II.

17536 L.Meichsner.

Phys. Rev., Vol. 120, No. 2, 552-5 (Oct. 15, 1960).

For Pt I, see Abstr. 7507 of 1960. General formulae are given for the differential probability of allowed double β decay of nonoriented nuclei holding for any initial angular momentum and all possible final angular momenta according to the theory of Feynman and Gell-Mann (Abstr. 507 of 1958). Six different combinations of reduced matrix elements occur. The decay probability for transitions $0 \rightarrow 2$ is small of second order compared with that for transitions $0 \rightarrow 0$. A lower limit for the half-life of the transition $0 \rightarrow 2$ of ${}_{20}Ca_{28}$ is calculated as a function of the intermediate nuclear energy using j-j shell-model configurations. A slight generalization of the coupling constants suitable for two-neutrino decay is considered.

539.16

DECAY OF ORIENTED NUCLEI BY ELECTRON CAPTURE.

17537 A.Gel'berg.

Rev. de Physique (Bucarest), Vol. 4, No. 4, 435-40 (1959). In Russian.

A direct measurement of the angular distribution of recoil nuclei from such decays is difficult. Resonance scattering of γ-rays is suggested as a practical experiment. The effective cross-section is evaluated for γ-rays scattered parallel and opposite to the axis of orientation. Information about the weak interaction Hamiltonian can be obtained. D.W.L.Sprung

539.16

17538 INNER BREMSSTRAHLUNG-NUCLEAR RECOIL ANGULAR CORRELATION IN K-CAPTURE.

S.D.Bloom and J.L.Uretsky.

Nuovo Cimento, Vol. 17, No. 3, 304-15 (Aug. 1, 1960).

It is suggested that a measurement of the inner bremsstrahlung (IB)-nuclear recoil angular correlation in K-capture leads to a method for determining the ratio $|C_A|^2/|C_V|^2$, which is substantially free from dependence on either lifetime or spectral-shape factors, in contrast to the estimates of $|C_A|^2/|C_V|^2$ made from the ft values. So far a determination such as suggested here has been made only in the case of the β-decay of aligned neutrons. In the case of Be^7, the only known super-allowed K-capturer, a similar measurement might be of considerable interest since here some fairly dependable calculations of $|M_{GT}|$, the Gamow—Teller matrix element, might be made. (Knowledge of M_{GT} is essential in the evaluation of $|C_A|^2/|C_V|^2$). A general formula is derived for the IB-nuclear recoil angular correlation and applied to the particular case of the $\mathrm{Be}^7 \xrightarrow{\text{K-capture}} \mathrm{Li}^7$ β-decay. In addition, it is shown that the formula, which in its general form assumes an initial (arbitrary) polarization for the K-capturing nucleus, offers the possibility of doing an unambiguous time-reversal experiment by looking for a left—right asymmetry in the count rate when polarization, recoil-momentum direction, and IB-direction are all mutually perpendicular.

539.16 : 539.18

17539 K-ELECTRON EXCITATION ACCOMPANYING K CAPTURE IN Cs^{131}. N.L.Lark and M.L.Perlman.

Phys. Rev., Vol. 120, No. 2, 536-42 (Oct. 15, 1960).

The probability of production of an atom with a completely vacant K shell by excitation of the second K electron during the K-electron capture process has been determined to be $(2.5 \times 0.2) \times 10^{-5}$ per K-capture event in Cs^{131}. A scintillation coincidence spectrometer with a coincidence resolution time of 10 mμsec for 30 keV X-rays was used for the measurement. The half-life of Cs^{131} was redetermined to be 9.69 ± 0.05 days. Previous measurements of electron excitation phenomena accompanying K-capture are summarized and the results are compared with the theory of Primakoff and Porter (Abstr. 3559 of 1953).

539.16

17540 ELECTRON CAPTURE OF Ba^{133} AND EXCITED STATES OF Cs^{133}.

S.D.Kiočki, A.M.Mijatović and J.M.Simić.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 8, 1-15 (March, 1958).

The decay Ba^{133} → Cs^{133} was investigated by means of a coincidence scintillation spectrometer. The energy values of the most intense transitions were determined as: 81, 302 and 355 keV. Five new gamma-transitions were found having energies: 53, 78, 160, 274 and 380 keV. The results of the coincidence measurements are given for these gamma-rays. A consistent decay scheme is proposed for Ba^{133} → Cs^{133}. The spin and parity values for the states in Cs^{133} are discussed, together with possible consequences for the Coulomb excitation of Cs^{133}. It is also found that the mean mode of the decay of Ba^{133} is K-capture to the highest excited level of Cs^{133}, which disagrees with the previously reported results. The possible explanation of this capture is discussed.

539.16

17541 NUCLEAR STRUCTURE EFFECTS IN Cs^{133}.

M.K.Ramaswamy.

Phys. Rev., Vol. 119, No. 6, 2021 (Sept. 15, 1960).

The 79 keV transition in Cs^{133}, which is known to be l-forbidden ($\Delta l = 2$) magnetic dipole (M1), was analysed for penetration effects suggested by Church and Weneser (Abstr. 2614 of 1957). A value of 6.5 ± 2.6 is found for λ, the ratio of the matrix element due to penetration of the atomic electron into the nucleus and the matrix element due to M1 gamma emission. This value of λ is to be compared with the range 5-10 obtained by Church and Weneser for l-forbidden ($\Delta l = 2$) transitions using empirical gamma matrix elements and single particle wave functions to evaluate the electron matrix element.

539.16

17542 INTERACTION OF BETA-DECAY AND SECOND FORBIDDEN SPECTRUM OF Cs^{137}.

T.Katoh, S.Yamasaki and Y.Yoshizawa.

Nuclear Phys., Vol. 17, No. 4, 548-62 (July (2), 1960).

The allowed as well as non-unique first forbidden β-spectra are discussed, in particular, the second forbidden spectrum of (taking account of parity non-conservation. The analysis can be summarized in the following way: (i) from the consideration of Fierz terms in allowed as well as forbidden transitions, one ca treat the two combinations STP and VA separately. Though a li combination of the five interactions is possible, no interference term between STP and VA exists. (ii) In non-unique first forbid transitions the combination VA is more favourable than STP. (i From the second forbidden spectrum of Cs^{137} it follows that

$$\frac{\mathrm{Re}(C_X C_Y{}^* + C'_X C'_Y{}^*)}{|C_Y|^2 + |C'_Y|^2} \cong - \frac{|C_X|^2 + |C'_X|^2}{|C_Y|^2 + |C'_Y|^2}$$

where X and Y mean S and T, or V and A.

17543 DECAY OF Gd^{153}.

H.Leutz.

Z. Phys., Vol. 159, No. 4, 462-77 (1960). In German.

The electron capture decay of Gd^{153} was studied by mountin the radioactive source in three different ways: outside, in the centre, or incorporated in the lattice of a NaI:Tl crystal. The $P_{L+M+\ldots}/P_K$ capture ratio was measured for the transition the 97.5 and 103 keV levels and to the 172.5 keV level of Eu^{153} : 0.34 ± 0.02 and 0.85 ± 0.3 respectively. These results were used to determine the disintegration energy of Gd^{153} : 279.5 ± 8 keV and 269^{+26}_{-16} keV respectively. Branching ratios log ft values and conversion coefficients were determined.

5

17544 ON THE PSEUDOSCALAR INTERACTION IN $0^- \rightarrow$ (BETA TRANSITIONS. D.Tadić.

Nuclear Phys., Vol. 18, No. 1, 138-48 (Aug. (1), 1960).

The correction factors for the spectrum and longitudinal polarization of electrons in $0^- \rightarrow 0^+$ transitions for the axial ve and pseudoscalar interaction are calculated in the non-relativis approximation up to the order $(v/c)^2$. Various possible non-relativistic approximations are discussed. Numerical analysis undertaken for Pr^{144} → Nd^{144} transitions. Different results obtai in earlier analyses are explained. From measurements of long tudinal polarization of electrons it seems that $0^- \rightarrow 0^+$ transitio are difficult to explain by pure axial vector interaction.

53

17545 INVESTIGATION OF POLARIZATION OF INTERNA CONVERSION ELECTRONS EMITTED AFTER β-DE IN HEAVY ELEMENTS.

M.E.Vishnevsky, V.A.Lyubimov, E.F.Tretyakov and G.I.Grishuk

Nuclear Phys., Vol. 18, No. 1, 122-30 (Aug. (1), 1960).

The polarization of internal conversion electrons produced some transitions occurring after β-decay of Tm^{170}, Re^{186}, Hg^{203} Pa^{233} was measured. The conversion electrons were found to b polarized in the direction of emission of the β-particles from T and Re^{186} and opposite to the direction of emission of β-particle from Hg^{203} and Pa^{233}. The most probable values of the ground-state spins of β-decaying nuclei were determined for Hg^{203} and Pa^{233}. Agreement between the experimental and theoretical res was obtained for Tm^{170} and Re^{186} for which all transition consta are known.

5

17546 TRANSITION INTENSITIES IN THE Tl^{208} BETA DECAY, THE Bi^{212} → Po^{212} DECAY SCHEME, AND Bi^{212} BRANCHING RATIO.

G.Schupp, H.Daniel, G.W.Eakins and E.N.Jensen.

Phys. Rev., Vol. 120, No. 1, 189-98 (Oct. 1, 1960).

Studies were made on the Pb^{212} (ThB) active deposit by mea of gamma singles and beta—gamma, gamma—gamma, gamma—alpha, and gamma—alpha coincidence measurements. The singl and coincidence gamma-ray spectra were recorded on an RCL 256-channel analyser, and an intermediate-image beta-ray spec meter was used in the beta—gamma work. Beta intensities of 4.6 ± 0.2, 23.9 ± 0.8, 22.7 ± 0.7, 48.8 ± 2.7, and <0.5% were obtained for the 1.04-, 1.29-, 1.52-, 1.80-, and 2.38 MeV groups respectively, of the Tl^{208} → Pb^{208} decay. Existence of the 1.800 gamma ray in Po^{212} was established and 11.2 ± 0.7% of the Bi^{212} → Po^{212} disintegrations were determined to proceed by way of the 0.727 MeV transition. Relative intensities of 11.1 ± 0.7, 1.7 ± 0.3, 0.66 ± 0.07, 0.16 ± 0.04, 0.99 ± 0.08, 0.49 ± 0.05, 8 0.2, and 0.17 ± 0.03 were found for the 0.727-, 0.786-, 0.893-, 9 -, 1.073-, 1.513-, 1.620-, and 1.800 MeV gamma rays, respec- , in Po^{212}. The ratio of alpha to total disintegrations for the decay was measured to be 0.3596 ± 0.0006.

539.16

547 TEST OFPARITY CONSERVATION IN STRONG INTERACTIONS BY THE MEASUREMENT OF THE ANGULAR CORRELATION OF Xe^{133}.

H.Müller and H.Schopper.

o Cimento, Vol. 15, No. 5, 840-2 (March 1, 1960).

An estimate has been made of the asymmetry with respect to the $\beta-\gamma$ angular correlation in the β-decay of Xe^{133} to the V level in Cs^{133} and the subsequent γ-decay of this level. An lar distribution of the form $W(\theta) = 1 + A \cos \theta$ was assumed and alue for A was found to be 0.0012 ± 0.0010. Nonconservation rity in strong interactions leads to mixed nuclear states with -functions of different parities; F is defined as the ratio of the itude of the wave-function with wrong parity to that with right y. R is the ratio of the matrix element for a transition from tate using the initial wave-function of wrong parity to that using itial wave-function with right parity. In a $\beta-\gamma$ correlation riment such as the above, the quantity A would have the value .F. R was calculated by Krüger using two extreme methods, g the values R = 290 and 12. From these results and the experi- al value for A, two limits are given for F, respectively: 5×10^{-6} and $F \leq 1.3 \times 10^{-4}$. R.E.Meads

539.16

7548 MULTIPOLE ORDER OF THE 869 keV GAMMA RAY IN Sm^{152}.

O.Nathan.

ear Phys., Vol. 19, No. 2, 148-53 (Oct. (1), 1960).

The angular correlation of the 869–244 keV gamma—electron ade in Sm^{152} was measured and the multipole mixture of the keV transition deduced to be 98.8% E2, 1.2% M1. The influence e rotation—vibration coupling on the E2 and M1 transitions the γ-vibrational states in Sm^{152} is discussed. The value of coupling parameter z is found to be 0.08.

539.16

7549 INVESTIGATION OF INTERNAL BREMSSTRAHLUNG CROSS-SECTION WITH SPECIFIED ELECTRON AND TON ENERGIES.

J.E.Thun, B.G.Pettersson and K.Siegbahn.

lear Phys., Vol. 18, No. 1, 131-7 (Aug. (1), 1960).

The internal bremsstrahlung from P^{32} was measured by a cidence arrangement, where the electrons are detected in a spectrometer and the photons in a NaI:Tl scintillation crystal. selecting a certain energy in the β-spectrometer it was possible est the differential probability for the internal bremsstrahlung ssion as given by the theory of Knipp and Uhlenbeck (1936). The e between the electron and photon is chosen to be 90^0. The ilt shows good agreement for all electron energies chosen.

539.16

7550 DOUBLE CONVERSION.

J.Eichler.

Phys., Vol. 160, No. 3, 333-46 (1960). In German.

An excited nuclear state can decay by three different modes of ble quantum emission: double γ-emission, γ—electron emission double conversion electron emission. The emission of two uanta was considered in an earlier paper (Abstr. 1366 of 1960). purpose of the present work is to treat all three processes ether in a systematic manner. It is shown that the connection ween the transition rates for γ—electron emission $T_{\gamma c}$ and ble γ-quantum emission $T_{\gamma\gamma}$ is more complicated than in the e of single quantum processes. However, $T_{\gamma c}$ can still be ex- ssed in terms of the usual conversion coefficients. This is also e for the transition rate T_{cc} for the emission of two K-shell ctrons, although only approximately. For the emission of elec- ns from different atomic shells the formulae become rather com- ated, because of interference effects. The electron and γ- ntum spectra in all of the three second order processes are cussed in detail for the decay of the isomeric level in Xe^{131}.

539.16

17551 LIFETIMES OF THE FIRST EXCITED STATES OF F^{17} AND O^{17}.

.Kane, R.E.Pixley, R.B.Schwartz and A.Schwarzschild.

ys. Rev., Vol. 120, No. 1, 162-8 (Oct. 1, 1960).

Using the gamma—gamma coincidence method and an electronic e-to-amplitude converter, the lifetimes of the first excited states the mirror pair O^{17}(0.87 MeV) and F^{17}(0.50 MeV) were measured. The reactions initiating the gamma cascades were $O^{16}(d,p)O^{17*}$ and direct proton capture in O^{16}. The time resolution of the coincidence circuit was good enough to allow the lifetime measurements to be made by direct observation of the exponential decay, rather than by measurement of the centroid shift. The measured mean life of O^{17*} is $(2.55 \pm 0.13) \times 10^{-10}$ sec; the measured mean life of F^{17*} is $(4.45 \pm 0.22) \times 10^{-10}$ sec. Both of these results are in reasonable agreement with earlier, less accurate values. See also following abstract.

539.16 : 539.14

17552 COLLECTIVE QUADRUPOLE EFFECTS IN LIGHT NUCLEI.

B.J.Raz.

Phys. Rev., Vol. 120, No. 1, 169-74 (Oct. 1, 1960).

The recent measurements of the lifetimes of the first excited states of the mirror nuclei O^{17} and F^{17} (see preceding abstract) have raised new interest in the various theoretical interpretations of these lifetimes. In this work the weak-coupling collective model of Bohr and Mottelson is applied to these E2 transitions and to the similar E2 transitions that have been measured in N^{16}, F^{19}, and Ne^{19}. If the harmonic oscillator radial wave-functions are used in evaluating the radial integrals in the theory, the predictions match the experimental results for the E2 transition probabilities in N^{16}, O^{17}, F^{17}, and F^{19} and the quadrupole moment of O^{17}. The theoretical prediction is an order of magnitude smaller than the experimental result for transition probability of the first excited state of Ne^{19}.

539.16

17553 LIFETIME MEASUREMENTS ON THE FIRST EXCITED STATES OF Mg^{25} AND Al^{25}.

A.T.G.Ferguson, M.A.Grace and J.O.Newton.

Nuclear Phys., Vol. 17, No. 1, 1-8 (June (2), 1960).

The lifetimes of the first excited states of the nuclei Mg^{25} and Al^{25} were measured using both $\gamma-\gamma$ coincidences and pulsed-beam methods. The values obtained were $\tau_{1/2}(Mg^{25}) = 3.5 \pm 0.2 \times 10^{-9}$, $\tau_{1/2}(Al^{25}) =$ $= 1.8 \pm 0.3 \times 10^{-9}$. The difference between the reduced transition probabilities for these two which amounts to a factor of 10 is attributed to the fact that one is an odd-proton and the other an odd-neutron transition.

539.16

17554 $\gamma-\gamma$ CORRELATION MEASUREMENTS ON Sm^{152}, Gd^{152} AND Gd^{154}: SPIN SEQUENCE, MIXING RATIO AND g-FACTOR.

P.Debrunner and W.Kündig.

Helv. phys. Acta, Vol. 33, No. 5, 395-428 (1960). In German.

Angular correlation methods were used to establish the spin sequence and the multipole mixing ratio of several γ-rays cascades in the decay of Eu^{152}, Eu^{152m} and Eu^{154}, and to measure the nuclear g-factor of Sm^{152}. For liquid sources, only the 123 keV level of Gd^{154} showed attenuation. It was found that each level in the decay of Eu^{152} to Sm^{152} corresponds to a level of the same spin and parity in the decay of Eu^{154} to Gd^{154}. In Gd^{154} an additional 2^- level of 1721 keV exists, which decays by E1 radiation to the 2^+, K = 2 and the 2^+, K = 0 levels. The measurements of the 1290 keV—344 keV and 1100 keV–344 keV cascades in Gd^{152} are consistent with a tentative spin assignment of 2 or 3 to the (1634 ± 25) keV level and of 4 to the 1444 keV level. The g-factor of the first rotational state of Sm^{152} was measured using liquid and polycrystalline sources. Assuming the internal field of the paramagnetic electron shell to be proportional to T^{-1}, the experimentally observed values $g_{eff} = 0.38 \pm 0.06$ at 300^0K and $g_{eff} = 0.180 \pm 0.065$ at 1200^0K yield a g-factor $g_N = 0.115 \pm 0.075$.

539.16

17555 M1/E2 MIXING RATIO IN THE Fe^{57} 14.41 keV γ– TRANSITION.

G.T.Ewan, R.L.Graham and J.S.Geiger.

Nuclear Phys., Vol. 19, No. 2, 221-4 (Oct. (1), 1960).

Deduced from a measurement of the $L_I/(L_{II} + L_{III})$ conversion line intensity ratio. The measured value $L_I/(L_{II} + L_{III}) = 10.9 \pm 0.8$ is compared with Rose's theoretical L sub-shell conversion coefficients extrapolated to 14.41 keV. This comparison indicates that the γ-transition has an E2 quantum admixture of less than 10^{-4}. This limit means that there is no strong enhancement of the E2 transition probability over the single particle estimate.

539.16 : 539.14

ROTATIONAL-STATE TRANSITIONS IN ODD-MASS NUCLEI. See Abstr. 17482

539.16 : 539.17

γ-RADIATION FROM INTERACTION OF 14 MeV NEUTRONS. See Abstr. 15598

539.16

17556 GAMMA RAYS FROM ^{196}Au.

R.K.Gupta.

Physica, Vol. 26, No. 1, 69-74 (Jan., 1960).

The gamma-ray spectrum was investigated with a scintillation spectrometer. New gamma rays of 1080 ± 20 and 725 ± 20 keV were detected. Summing studies indicate a new level at 1080 ± 20 keV in Pt^{196}. Some indication is found for the existence of a weak ground-state transition from the 685 keV level in Pt^{196}.

539.16

17557 THE HALF-LIFE OF THE FIRST EXCITED STATE OF B^{10}.

S.Gorodetzky, R.Richert, R.Manquenouille and A.Knipper.

Nuclear Phys., Vol. 17, No. 4, 684-5 (July (2), 1960). In French.

The half-life of the 729 keV state of B^{10} was measured by means of a fast time-to-amplitude converter. The observed value was $T_{1/2} = (6.2 \pm 0.3) \times 10^{-10}$ sec.

539.16 : 539.17

17558 9.0-MeV GAMMA-EMITTING LEVEL IN C^{12}.

D.E.Alburger and R.E.Pixley.

Phys. Rev., Vol. 119, No.6, 1970-4 (Sept. 15, 1960).

An energy level in C$^{1/2}$ at 9.0. ± 0.1 MeV was detected by means of (p,γ,γ) coincidence measurements on the B^{10}(He^3,p)C^{12} reaction at $E_{He^3} = 2.2$ MeV. This state decays by a γ–γ cascade through the 4.43 MeV first excited state. An upper limit of 5% is placed on the ground-state γ-ray transition. The intensity of the proton group leading to the 9.0 MeV state (followed by γ-ray emission) is 0.21 ± 0.07% relative to the proton branch to the 4.43 MeV level. Gamma-ray branches from the 15.10 and 12.78 MeV states in C^{12} to the 4.43 MeV level were determined as (4 ± 1)% and (20 ± 7)%, respectively, relative to the corresponding ground-state transitions. The radiations from the 9.0 MeV level have prevented a sensitive search from being made for the 3.2 MeV γ-radiation from the 7.66 MeV level in C^{12} by means of this reaction.

539.16

17559 MEASUREMENT OF COBALT-60 AND CESIUM-137 GAMMA RAYS WITH A FREE-AIR CHAMBER.

H.O.Wyckoff.

J. Res. Nat. Bur. Stand., Vol. 64C, No. 2, 87-97 (April-June, 1960).

Design data for free-air chambers for making these measurements in roentgens are presented. It has been shown that the Jaffé–Zanstra method of obtaining the saturation current is adequate for air pressures of about 4 to 12 atm. Also, radiation measurements of these gamma rays made by a cavity chamber and a free-air chamber agree to within the experimental errors.

539.16

17560 THE GAMMA RAY SPECTRA OF ^{65}Ni AND ^{65}Zn; CHARACTERISTICS OF THE LOWER EXCITED STATES OF ^{65} Cu.

R.A.Ricci, G.Chilosi, G.Varcaccio, G.B.Vingiani and R.Van Lieshout.

Nuovo Cimento, Vol. 17, No. 4, 523-34 (Aug. 16, 1960).

The γ-ray spectra of Ni^{65} and of Zn^{65} were studied by scintillation techniques. It is shown that the first excited state of Cu^{65} at 770 keV is not populated in either of the decays. In Ni^{65} (Half-life: (2.50 ± 0.03) hr) two new γ-rays of (1.63 ± 0.05) MeV (1.73 ± 0.05) MeV were found, which originate at levels of the same energy known to exist in Cu^{65}. Evidence is presented that the level at 1.482 MeV does not belong to the quartet of levels arising from the coupling of the 29th proton ($p_{3/2}$) to the Ni^{64} core in its first excited 2^+ state (at 1.34 MeV), as assumed by Lawson and Uretsky in their application of the centre-of-gravity theorem to Cu^{65}. Agreement with this theorem is obtained for certain spin assignments to the other four excited states in Cu^{65} below 2 MeV.

539.16

17561 THE DECAY OF THE 136 keV LEVEL IN Fe^{57}.

A.T.G.Ferguson, M.A.Grace and J.O.Newton.

Nuclear Phys., Vol. 17, No. 1, 9-15 (June (2), 1960).

Coulomb excitation of the 136 keV state in Fe^{57} was made using 2 MeV helium ions and a number of its properties were studied. The angular distributions of the γ-rays from this state were measured. Considerable perturbation of the state is required to explain these results. For the intensity of the 122 keV gamma-ray, relative to that of the 136 keV gamma-ray, a value of 8.6 ± 0.2 was obtained The half-life of the state was measured and found to be $(8.6 \pm 0.8) \times 10^{-9}$ sec. A measurement of the Coulomb excitation cross-section leads to a value for the upward B(E2) of $(0.043 \pm 0.005) \times 10^{-48}\,e^2cm^4$. This is consistent within the error of measurement with the lifetime result if it is assumed that the spin of the 136 keV level is $\frac{5}{2}$.

539.16 : 53

17562 THE DECAY MODES OF THE 9.17-MeV EXCITED STATE IN N^{14}. H.J.Rose.

Nuclear Phys., Vol. 19, No. 2, 113-39 (Oct. (1), 1960).

A search was made for the gamma rays and gamma-cascade transitions resulting from the decay of the 9.17 MeV excited stat in N^{14} using the reaction C^{13}(p, γ)N^{14} at the 1.75 MeV resonance. The main purpose of the investigation was to gain information ab the "missing" (2,0) and (2,1) levels arising from the p^{-2} configuration in mass 14 by obtaining a detailed decay scheme for the 9.17 MeV state. Three-crystal pair spectrometer techniques we used in order to search for gamma rays too weak to be detected by single spectra measurements in the presence of the strong 9.17 MeV to ground-state transition. In addition to the previousl reported transitions from the 9.17 MeV state to the ground-state and the 6.44 MeV excited state, a transition was observed to the 7.03 MeV excited state. Three-crystal pair spectra measuremen and coincidence measurements indicate a transition from the 9.17 MeV excited state to the (presumably) odd-parity T = 0 state 5.83 MeV and possibly to the 5.69 and 5.10 MeV states. Upper li on the transitions to the 5.69 and 5.10 MeV states have been place Observation of gamma rays with energies of 1.64 MeV and 2.49 M in three-crystal pair spectra measurements and in several coincidence measurements give evidence that the 6.44 MeV excited stat branches to the 3.95 MeV (1,0) state. To obtain anisotropies and intensities relative to the 9.17 MeV → ground-state transition for the gamma rays observed, three-crystal pair spectra have been taken at 0° and 90° relative to the proton beam. The results of th measurements (combined with results about the 9.17 to 6.44 MeV ground-state transition published recently) lead to spin assignme of J = 2 to the 9.17 MeV level and of J = 3 to the 6.44 MeV level. Furthermore, they lead to a spin assignment of J = 2 to the 7.03 MeV excited state in N^{14}. The latter assignment and compar son of the strength of the 9.17 to 7.03 MeV transition with results of calculations obtained by Warburton and Pinkston (Abstr. 9531 c 1960) suggest that the 7.03 MeV excited state arises from the p^{-2} configuration as (2,0) level and that the 9.17 MeV level at leas in part arises from p^{-2} as (2,1) level. Comparison of the dipole–quadrupole mixture ($0.13 < \delta < 3.5$) in the 7.03 MeV to ground-state transition, which was determined from the measured anisotropy of this transition, with theoretical results of Warburton and Pinkston agrees with this conclusion.

539.

17563 EVIDENCE FOR A NEW 191 MIN HALF-PERIOD ACTIVITY IN Nb.

M.Bocciolini, G.Di Caporiacco, L.Foà and M.Mandò.

Nuovo Cimento, Vol. 16, No. 4, 780-1 (May 16, 1960).

The spectrum of γ-rays accompanying the decay of active pr ducts resulting from the irradiation of Nb with fast neutrons from the H^3(d,n)He^4 reaction was observed. The well-known 934 keV γ-ray following the decay of 10.15 day Nb^{92} was seen, together wit unidentified γ-rays of 200 keV and 495 keV energy, with a half-lif corrected for long-lived background, of 191 min. These γ-rays were of equal intensity and in coincidence. The ratio of the produ tion cross-section for this activity to that of the 10.15 day activity was found to be 0.018. The 191 min activity was tentatively assig to a metastable state of Nb^{92} other than those believed to occur at 2.35 MeV and 0.088 MeV. R.E.Mea

539.

17564 STUDIES OF DECAY SCHEMES IN THE OSMIUM–IRIDIUM REGION. II. DECAY OF 12-DAY Ir^{190}.

W.R.Kane, G.T.Emery, G.Scharff-Goldhaber and M.McKeown.

Phys. Rev., Vol. 119, No. 6, 1953-69 (Sept. 15, 1960).

For Pt I, see Abstr. 2766 of 1959. Spectra of the gamma rays and internal conversion electrons emitted in the decay of 12-day I were studied in detail. Internal conversion spectra were obtained with the aid of double-focusing and intermediate-image beta spect meters, and a permanent-magnet spectrograph. Gamma-ray spec were obtained by means of photoelectric conversion, employing a double-focusing spectrometer, and by scintillation techniques. Th surements of the energies and relative intensities of gamma rays internal conversion electrons give internal conversion coefficients number of transitions. These data, coupled with coincidence ies of gamma rays, support the level scheme reported by Nielsen . for Os^{190} and establish new, odd-parity levels at 1384, 1568, 1876 keV. An upper limit of 2×10^{-5} is set on position branching e decay of Ir^{190}. Relative electron capture transition probabilities he decay of Ir^{190} to Os^{190} and ratios of reduced transition abilities for electromagnetic transitions from a number of levels s^{190} follow from these results. They are compared with the ictions of the strong-coupling model and the asymmetric rotor el. The half-life of Ir^{190} was found to be 12.3 ± 0.4 days. Even-A um—osmium total disintegration energies are found to rise tantially above the values predicted by semiempirical mass ulae, suggesting a possible effect of the change in the nuclear rmation in this region.

539.16 : 539.14

ANGULAR CORRELATION MEASUREMENTS ON Pm^{147}

Abstr. 17481

539.16

7565 COINCIDENCE STUDIES OF GAMMA-RADIATIONS FROM Yb^{169} AND Er^{171}. S.D.Koički and A.M.Koički.

. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 1-19 (March, 1956).

Gamma-rays from 33 day Yb^{169} and 7 hr Er^{171} were investigated neans of a coincidence scintillation spectrometer. Gamma-s of 63, 93, 110, 132, 178, 198, 260 and 308 keV are found in and those of 112, 125, 294 and 307 keV in Er^{171}. Decay emes for both isotopes are proposed and the similarities in structure of excited states of isotopes Tm^{169} and Tm^{171} discus- The position of the metastable state is established in both opes, as well as the rotational character of first three excited es. The characteristic rotational parameters obtained from osed schemes are compared with the Bohr—Mottelson theory.

539.16

7566 PRECISION MEASUREMENTS OF GAMMA ENERGIES AND INTENSITIES BY CRYSTAL DIFFRACTION.

ergvall.

. Fys., Vol. 17, Paper 7, 125-47 (1960).

Precision measurements of gamma energies from 100 to keV in the decays of ThB, Au^{198}, Sm^{153}, and Ir^{192} are reported the following results for three strong standard reference lines: , 238.599 ± 0.022 keV; Au^{198}, 411.770 ±/0.033 keV; Sm^{153}, 175 ± 0.004 keV. An efficiency calibration of the curved crystal uartz (310), (1.5 mm thick and 2 m radius), is found to give the owing energy dependence of the reflection coefficient: $E^{-1.99 \pm 0.01}$. The spectrometer efficiency is further discussed relative intensities of some strong lines in Ir^{192} are given.

NUCLEAR REACTIONS

539.17

7567 THEORY OF RESONANCE REACTIONS. L.Fonda and R.G.Newton.

. Phys. (New York), Vol. 10, No. 4, 490-515 (Aug., 1960).

A general formal theory of resonance reactions and scattering developed without the use of channel radii. The approach em-yed allows a simple physical interpretation of the two energies, of which must be kept fixed while the other one is varied in er for a Breit—Wigner denominator to vanish. A new result, ained without a weak channel coupling hypothesis, is that a sharp onance may be caused by forces which, if slightly different, would d to a stable bound state even in the presence of strong coupling open channels. The possibility of shapes other than the usual eit—Wigner type is also discussed. A special formula is derived resonances near a threshold caused by bound states just below t threshold in the same channels where the peak is seen.

539.17

17568 VIRTUAL BINDING AND ITS RELATION TO RESONANCE SCATTERING. G.L.Trigg.

er. J. Phys., Vol. 28, No. 8, 711-15 (Nov., 1960).

A discussion of virtual binding and resonance scattering is sented in such a fashion as to make clear the relationship ween them.

539.17

17569 RESONANCE REACTIONS WITH GENERALIZED ONE-LEVEL APPROXIMATION. H.Lustig.

Nuclear Phys., Vol. 17, No. 2, 317-28 (June (3), 1960).

A formalism is developed for the analysis of nuclear reactions which involve partially overlapping resonance levels. The Wigner R matrix, for each value of the total angular momentum and of the parity, is divided into a single-level matrix and an energy-dependent background matrix. The collision matrix, in the form defined by Blatt and Biedenharn may then be expressed, for an N-channel reaction, in terms of the N partial widths of the tagged level, N "potential" phase shifts, and the $\frac{1}{2}N(N + 1)$ parameters of the unitary and symmetric background matrix. By invoking the unitarity and symmetry of the collision matrix itself, the number of independent parameters in the background matrix is then reduced to $\frac{1}{2}N(N-1)$. An explicit recipe is given for the construction of the collision matrix, and is illustrated for N = 2 and N = 3. In this formalism, the separation between the strongly energy-dependent single-level part and the contributions from the background matrix is preserved throughout; the formalism will thus be practically useful when the latter varies slowly with energy in the region of the tagged resonance. The further simplifications which occur when the background matrix is diagonal, or nearly diagonal, are discussed.

539.17

17570 THEORY OF RADIATIVE CAPTURE IN THE RESONANCE REGION. A.M.Lane and J.E.Lynn.

Nuclear Phys., Vol. 17, No. 4, 563-85 (July (2), 1960).

Starting from nuclear dispersion theory, a formalism is presented for the analysis of capture reaction cross-sections at energies in the resonance region. Account is taken not only of capture through local resonances but also of "direct" or "potential" capture. The latter contributes to the cross-section a smooth background with which resonances interfere. Estimates show that, in certain favourable cases, the direct capture can predominate. An important feature of direct capture (and also of the channel contribution to resonance capture) is that it tends to select final single-particle states and so gives rise to anomalous groups in the photo spectrum. See also following abstract.

539.17

17571 ANOMALOUS RADIATIVE CAPTURE IN THE NEUTRON RESONANCE REGION: ANALYSIS OF THE EXPERIMENTAL DATA ON ELECTRIC DIPOLE TRANSITIONS.

A.M.Lane and J.E.Lynn.

Nuclear Phys., Vol. 17, No. 4, 586-608 (July (2), 1960).

The formalism of the earlier paper (see preceding abstract) is used in a semi-quantitative attempt to analyse one of the most striking systematic features of low-energy neutron-capture γ-ray spectra, namely, the strong group of high-energy transitions occurring in the spectra for nuclei below mass 208 and around mass 50. This is anomalous in the sense that it does not concur with the qualitative expectations from statistical theory. It is found that close to the giant resonance in the s-wave neutron strength function at $A \cong 50$ the anomaly appears to be associated with a selection rule operating in resonance capture while for lighter nuclei and for capture in some of the lead isotopes there is strong evidence that it is a consequence of "direct" or "potential" capture.

539.17

17572 CLASSICAL THEORY OF COMPOUND NUCLEUS REACTIONS. T.Ericson.

Nuclear Phys., Vol. 17, No. 2, 250-63 (June (3), 1960).

The emission of particles from a compound system to individual states in the residual nucleus is studied in the classical limit of large angular momenta. Expressions are derived for total and differential cross-sections, when the target spin is polarized and unpolarized under different initial and final conditions. It is found that the angular distribution has a very simple classical limit, when the dependence on angular momentum of the penetrabilities of the emitted particle can be neglected.

539.17

17573 SYMMETRY PROPERTIES OF THE DISTORTED WAVE THEORY OF DIRECT NUCLEAR REACTIONS.

G.R.Satchler.

Nuclear Phys., Vol. 18, No. 1, 110-21 (Aug. (1), 1960).

It is shown that under certain simple conditions often nearly realized experimentally, the transition amplitudes in the distorted wave Born approximation theory of direct nuclear reactions have a simple symmetry under interchange of the distorted waves for initial and final states. For observations on the reaction the symmetry is equivalent to rotating coordinate axes by π about the recoil direction. This property is used to show in detail how the initial and final distortions have opposing effects for some phenomena (such as polarization of emitted particles or change of symmetry axis for the distribution of subsequent γ-rays) but are co-operative for others (such as the differential cross-section). Some conclusions are drawn about distortion effects in various types of reaction.

539.17

17574 ON THE RELATIONS BETWEEN SPIN POLARIZATIONS AND DISTORTED WAVE THEORY OF THE DIRECT REACTIONS.

S.Okai.
Progr. theor. Phys., Vol. 22, No. 1, 89-100 (July, 1959).

The spin polarization in the distorted wave theory of stripping is presented in a general form, and the interesting problems are discussed, such as, what polarization comes from what types of the distortion of the wave-functions. Under certain conditions, exact relations are derived between the signs of polarization and the distortion of particle wave-functions. It is pointed out that similar relations are also present in other direct reactions. As an example, polarization in inelastic scattering is studied briefly.

539.17

17575 ^{8}Li FRAGMENTS ASSOCIATED WITH NUCLEAR DISINTEGRATION.

A.Alumkal, A.G.Barkow, G.Kane, R.E.McDaniel and Z.O'Friel.
Nuovo Cimento, Vol. 17, No. 3, 316-33 (Aug. 1, 1960).

This is a preliminary report on the emission of heavy fragments in nuclear disintegration. It is assumed that the probability of emission of a heavy fragment depends on the nuclear temperature (T) and the potential barrier (V) of the excited nucleus. It is the purpose of this investigation to study the dependence of the differential energy spectrum on the excitation energy. The data collected were from four stacks of Ilford G-5 emulsions, exposed to (a) a stopped pion beam; (b) 400 MeV proton beam; (c) (4-5) GeV pion beam and (d) cosmic rays with an exposure in Texas, magnetic latitude of 41° N, and on the Island of Guam at the magnetic equator. Emphasis is placed on the emission of Li^8 as the heavy fragment. The results of the experiment indicate that for high excitation energy there is a collimation of lithium and beryllium fragments in the forward direction which may be explained on the basis of evaporation theory by assuming the fragment emission to take place during the flight of a highly excited nucleus. In the case of low excitation energy the angular distribution of Li^8 fragments is isotropic and the energy distribution indicates that the majority result from the absorption of a π^--meson by a light nucleus.

539.17

17576 A BREMSSTRAHLUNG EXPERIMENT TO MEASURE THE TIME DELAY IN NUCLEAR REACTIONS.

R.M.Eisberg, D.R.Yennie and D.H.Wilkinson.
Nuclear Phys., Vol. 18, No. 2, 338-45 (Aug. (2), 1960).

It should be possible to measure the time delay in a nuclear reaction, in which both the incident and product particles are charged, by measuring the spectrum of the bremsstrahlung that is produced. The time delay enters the spectrum through a phase factor between the bremsstrahlung amplitude associated with the cessation of the current due to the incident particle and the bremsstrahlung amplitude associated with the initiation of the current due to the product particle. The classical theory of this bremsstrahlung production process is developed, and results which will be useful in estimating the feasibility of a measurement are obtained. Because of the recoil of the charged nucleus, this technique could also be used even if the incident and/or product particles are uncharged.

539.17 : 539.12

17577 NEW TYPE OF ANGULAR-DISTRIBUTION CHAMBER.

R.L.Clarke.
Nuclear Instrum., Vol. 3, No. 4, 233-6 (Oct., 1958).

A chamber to be used in the observation of charged particles from nuclear reactions is described. This chamber allows observations to be taken over the continuous range -25° to $+145^\circ$ with respect to the incident beam without opening the vacuum system.

539.17

17578 ON THE INELASTIC SCATTERING BY DEFORMED NUCLEI.

Z.Jankovic.
Nuovo Cimento, Vol. 17, No. 3, 281-7 (Aug. 1, 1960).

A more general treatment of the nuclear inelastic scattering on even—even target nuclei is given particularly by introducing other collective target states besides rotational ones, the defor diffuse nuclear and spin-orbit potentials and the Coulomb potent for the deformed target nucleus. In the first order approximati explicit expressions for the differential cross-section and for th total cross-section for the transition 0 → 2 are deduced.

5

17579 ON THE INTERMEDIATE RESONANCE LEVELS IN NUCLEAR REACTIONS.

S.Igarasi, K.Izumo and T.Udagawa.
Progr. theor. Phys., Vol. 21, No. 3, 468-71 (March, 1959).

The levels are discussed in terms of a model in which the incident nucleon interacts strongly with several, but not all, the nucleons in the target nucleus. C.J.

5

17580 THE IMAGINARY PART OF THE OPTICAL POTEN

A.Sugie.
Progr theor. Phys., Vol. 21, No. 5, 681-95 (May, 1959).

The form of the imaginary part of the optical potential for t nucleon—nucleus interaction is derived as an operator for the fi nucleus. This is done by reducing the Schrödinger equation app mately. It is essentially a second-order calculation but this is supported by the intermediate coupling model and the assumptio that the non-diagonal elements of the interaction matrix have ra signs. The imaginary part thus obtained is a non-local but almo separable potential. The form allows the physical interpretatio that the imaginary part corresponds to the process in which the incident nucleon jumps down to an unoccupied single particle sta below the incident energy and excites the target nucleus, making total energy nearly conserved. It is suggested that the imaginar part may become abruptly stronger as the shape resonance is pa since in this case there is a single particle state just below the incident energy and the corresponding excited states of the targ are near the ground state. The relation to Bloch's theory is als discussed.

5

17581 DIRECT INTERACTION IN THE p—2p REACTION.

A.M.Green and G.E.Brown.
Nuclear Phys., Vol. 18, No. 1, 1-13 (Aug. (1), 1960).

An analysis of (p, 2p) reactions is carried out and it is poin out that, with good energy resolution in detection of the particle it would be possible to obtain important information about the energies of shell-model levels. Treatment of the direct-intera part of the process as a surface reaction is justified. Calculati in the direct-interaction formalism show strong correlations in angle of the two emitted protons.

539.17 : 5

SOME (p,n) REACTIONS. See Abstr. 17504

5

17582 MASS ANALYSIS OF THE SECONDARY PARTICLE PRODUCED BY THE 25 GeV PROTON BEAM OF T CERN PROTON SYNCHROTRON.

V.T.Cocconi, T.Fazzini, G.Fidecaro, M.Legros, N.H.Lipman and A.W.Merrison.
Phys. Rev. Letters, Vol. 5, No. 1, 19-21 (July 1, 1960).

Mass analysis was performed on the secondary particles energing at 15.9° from aluminium and platinum targets exposed the 25 GeV proton synchrotron, using magnetic deflection and ti of-flight measurements. Results are given for the frequency, r tive to pions, or protons, deuterons, and K-mesons in the mome tum range 2-5 GeV, and for the momentum spectrum of pions. protons form 0.3% at 2 GeV/c and 1.1% at 4.7 GeV/c of the neg particles. There is a surprisingly large number of deuterons, amounting to about 3% of the protons from the platinum target.
S.J.Gold

539.17 : 5

GAMMA-RAY SPECTRA FROM Al^{27} (p,γ) Si^{28} RESONANC
See Abstr. 17505

539.17 : 5

$C^{13}(p,n)N^{13}$: RESONANT ENERGIES. See Abstr. 17499

5

17583 REACTION C^{14} (p,n) N^{14}..

J.K.Bair, R.D.Edge and H.B.Willard.
Phys. Rev., Vol. 119, No. 6, 1948-52 (Sept. 15, 1960).

The reaction was studied up to 5 MeV bombarding proton e good resolution using targets of high isotopic enrichment. Levels iously unseen in this reaction were found at proton energies of MeV (Γ = 6 keV), 3.38 MeV (Γ = 24 keV), 3.63 MeV (Γ = 13 keV), MeV (Γ = 35 keV), 4.19 MeV (Γ = 112 keV), 4.24 MeV (Γ = 27 keV), MeV (Γ = 140 keV), and 4.93 MeV (Γ = 106 keV). Excitation es at three angles in the region of 2.9 MeV proton energy show ffect of the previously known J = $\frac{3}{2}^-$ (Γ = 80 keV) resonance inter- ig with a level of opposite parity. Effects of the nearby $^-$ (Γ = 40 keV) level were not seen, presumably due to the low trability of the outgoing F-wave neutron. The thresholds for second and third neutron groups were investigated using a um iodide detector. A new threshold, that for production of the l neutron group, was measured to be 4.910 ± 0.008 MeV in ement with the known energy of the second excited state in N^{14}.

539.17

7584 QUASI-ELASTIC SCATTERING OF 153 MeV PROTONS BY p-STATE PROTONS IN C^{12}. I. EXPERIMENTAL.

.Gooding and H.G.Pugh.

lear Phys., Vol. 18, No. 1, 46-64 (Aug.(1), 1960).

For the reaction C^{12}(p,2p)B^{11} at 153 MeV, the energies of the protons emitted in each event were measured with plastic tillators, and added. The summed-energy spectrum showed a l-defined peak corresponding to an energy loss of 16 MeV in the ction, and events in this peak were interpreted as those in which roton is knocked out of the p-shell in carbon. For coplanar tate events, angular correlations and energy spectra were asured with one counter fixed at 15°, 20°, 30°, 40°, 60° and 80° tive to the incident beam and the angle of the other varied veen 15° and 80° on the other side of the beam. The angular relations were sharply peaked, while for the peak the separation le between the two outgoing protons depends markedly on the le at which one proton is detected, varying from 35° when the d counter is set at 15° to 110° when it is at 80°. The results are sistent with the mechanism of quasi-elastic p—p scattering when momentum distribution of the struck protons is taken into ount. A rough value is obtained for the total cross-section for tate events. It is about one-sixth of the expected value in the ence of absorption, thus showing the importance of this process. comparison of the experimental results with distorted-wave culations it should be possible to determine the momentum distribution of the p-state protons and the magnitude of the distortion cts themselves.

539.17

7585 QUASI-ELASTIC SCATTERING OF 153 MeV PROTONS BY p-STATE PROTONS IN C^{12}. II. THEORETICAL.

.Riley, H.G Pugh and T.J.Gooding.

lear Phys., Vol. 18, No. 1, 65-74 (Aug.(1), 1960).

The cross-section for the reaction C^{12}(p,2p)B^{11} is calculated events in which the residual nucleus is in its ground state. The ect interaction model is used, the reaction being considered in impulse approximation as quasi-elastic scattering. Both WKB- Born-approximation calculations predict the general features he reaction fairly well, confirming the validity of the above ure. The most important features to be taken into account in a re detailed calculation are investigated.

539.17

17586 A TARGET BOX FOR BOMBARDMENT OF CF$_4$ IN GASEOUS OR SOLID FORM.

3.Treacy and N.F.Bowkett.

clear Instrum., Vol. 1, No. 2, 86-9 (March, 1957).

The construction and operation is described of a target box in ch CF$_4$, either in gaseous or solid form, can be bombarded by tons and the angular distribution of soft (19 keV) radiation itted in the process F^{19}(p,p′γ) observed. Examples are given of se spectra obtained from solid CF$_4$ and from a conventional get of CaF$_2$.

539.17

17587 MOMENTUM DISTRIBUTION OF PROTONS IN INDIVIDUAL NUCLEAR SHELLS.

Hillman, H.Tyren and T.A.J.Maris.

ys. Rev. Letters, Vol. 5, No. 3, 107-8 (Aug. 1, 1960).

Angular correlation measurements are reported for quasi-free -p scattering in Li^7 at a bombarding energy of 180 MeV. Results e given for the two peaks ascribed respectively to the p$_{3/2}$ and the $_2$ protons. The former shows a dip at 90° corresponding to the v probability of zero momentum along the line of bombardment for protons. Correspondingly the other peak shows a maximum at 90°.

A.Ashmore

539.17

17588 AN ABSOLUTE DETERMINATION OF THE THRESHOLD ENERGY OF THE Li^7(p,N)Be^7 REACTION.

H.H.Staub and H.Winkler.

Nuclear Phys., Vol. 17, No. 2,271-8 (June (3), 1960). In German.

The threshold proton energy of the reaction Li^7(p,n)Be^7 was measured using the magnetic deflection technique in a homogeneous 180° field. The procedure of extrapolation of the yield curve is presented. The final value obtained was E$_S$ = 1880.3 ± 0.5 keV. A summary of all recent values of this threshold energy is presented. Revised values of resonance energies, measured previously by Bumiller and collaborators (1956), were calculated using the present measurements for an accurate correction for the permeability of the vacuum chamber.

539.17

17589 POLARIZATION OF NEUTRONS FROM THE REACTIONS Li^7(p, n)Be^7 AND D(d, n)He^3. J.A.Baicker and K.W.Jones.

Nuclear Phys., Vol. 17, No. 3, 424-34 (July (1), 1960).

The polarization of neutrons was measured for the Li^7(p, n)Be^7 reaction at a laboratory angle of 50° at bombarding energies from 3.0 to 6.0 MeV, and for the D(d, n)He^3 reaction at a laboratory angle of 40° at bombarding energies from 2.0 to 4.5 MeV. The polarization was determined from the left-right asymmetry in the scattering of the neutrons from liquid helium. A nanosecond time-of-flight system was used as a neutron spectrometer.

539.17

17590 COMMENT ON (p,n) CROSS SECTIONS.

R.Nakasima and H.Watanabe.

Progr. theor. Phys., Vol. 21, No. 3, 462-5 (March, 1959).

The cross-sections for (p,n) reactions for different isotopes of Ni, Cu and Zn are calculated, using the compound nucleus model, for energies below 12 MeV. Considerable variations from one isotope to another are found, in agreement with experimental results.

C.J.Batty

539.17

17591 ON THE REACTION O^{17}(p, γ)F^{18}.

M.M.Nikolić, B.Povh and C.Župančič.

Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 51-2 (March, 1956).

Describes the investigation of F^{18} produced by bombarding thick quartz targets with protons. An excitation curve showed a level at 1.24 MeV and the resonance cross-section was estimated to be of the order of 1 mb.

R.H.Thomas

539.17

17592 EXPERIMENTAL STUDY OF THE MECHANISM OF (p,t) REACTIONS AT 22 MeV.

J.B.Ball and C.D.Goodman.

Phys. Rev., Vol. 120, No. 2, 488-91 (Oct. 15, 1960).

Energy distributions of tritons from various elements throughout the periodic table show prominent peaks which can be identified with states in the residual nucleus resulting from the removal of two neutrons from single-particle states in the target. This is indicative of a double pickup mechanism for the (p,t) reaction at this energy. The use of this reaction in identifying the position and character of single-particle levels is illustrated. The reaction is also used to determine the mass of Ru^{101}.

539.17

17593 MOMENTUM IMPARTED TO COMPLEX NUCLEI IN HIGH-ENERGY INTERACTIONS. N.T.Porile.

Phys. Rev., Vol. 120, No. 2, 572-81 (Oct. 15, 1960).

The momentum imparted to nuclei in the cascade process is calculated with the aid of the results of a recent Monte Carlo calculation (Abstr. 654-5 of 1959). Results are presented for 0.46-1.84 BeV protons incident on Ru^{100}, Bi^{209}, and U^{238}. The forward and transverse components of momentum of the residual nucleus exhibit a wide range of possible values and are, on the average, approximately equal. The average forward component of momentum increases linearly with the excitation energy of the residual nucleus. The relation between these two quantities leads to considerably lower values of the average excitation energy associated with experimentally determined values of the forward component momentum than the relations used previously. The calculated momentum values are in most cases consistent with experimental results.

539.17

17594 GAMMA RAYS FROM THE PROTON BOMARDMENT OF NATURAL SILICON.

L.W.Seagondollar, G.I.Harris and L.K.Rangan.
Phys. Rev., Vol. 120, No. 1, 251-3 (Oct. 1, 1960).

The gamma-ray yield curve was observed when thin targets of natural silicon were bombarded with monoergic protons in the energy range of 300 to 1840 keV. In order to take small steps in proton energy, a target potential modulation technique was used. Fifty-five resonances were observed, all but fifteen of which have been observed elsewhere using targets enriched in Si^{29} or Si^{30}. The fifteen resonances at 369, 1096, 1134, 1204, 1290, 1382, 1472, 1484, 1507, 1570, 1598, 1617, 1625, 1630, and 1653 keV are presumed due to the Si^{28} + p reaction.

539.17

17595 PRODUCTION OF TRITIUM IN THORIUM BY 135 MeV PROTONS.

M.Lefort, G.Simonoff, X.Tarrago and R.Bibron.
J. Phys. Radium, Vol. 20, No. 12, 959-62 (Dec., 1959). In French.

The cross-section of tritium production by bombardment of thorium by 135 MeV protons was measured in the Orsay synchrocyclotron. The tritium was separated from the targets by heating in a graphite crucible with a high-frequency generator, under hydrogen gas pressure. Tritiated water was synthetized and the tritium was measured with a liquid scintillator. A value of 19.5 ± 0.5 mbarns was obtained for the tritium cross-section and ten percent of tritons had energies higher than 35 MeV. This large cross-section is attributed to a double pick-up process.

539.17

17596 REGULARITIES OF (d,α) REACTIONS IN HEAVY ELEMENTS.

J.B.Mead and B.L.Cohen.
Phys. Rev. Letters, Vol. 5, No. 3, 105-7 (Aug. 1, 1960).

Preliminary results are presented of a survey of (d,α) reactions produced by 15 MeV deuterons in heavy elements, using a proportional-counter scintillator telescope with a 256 channel pulse-height analyser. There is a high-energy peak gradually increasing from 18-24 MeV as Z increases from 40 to 90. This peak also shows strong forward peaking in angle, suggesting a direct interaction. Also there is a low-energy peak gradually increasing from 8-14 MeV as Z increases from 30-50 and disappearing rapidly for higher Z. This shows an almost isotropic angular distribution and is consistent with compound nucleus formation. The behaviour of the high-energy peak is discussed on the basis of a knockout or pick-up mechanism but is difficult to explain on either basis. A.Ashmore

539.17 : 539.14

17597 STUDY OF SOME EXCITED STATES OF B^{11} BY MEANS OF THE REACTION B^{10}(d,p)B^{11}.

S.Gorodetzky, M.Croissiaux, A.Gallmann, P.Fintz, J.Samuel and G.Bassompierre.
Nuclear Phys., Vol. 18, No. 2, 286-95 (Aug. (2), 1960). In French.

Some results are given of the angular distributions of protons and p—γ and γ—γ angular correlations for different levels which are obtained in the reaction B^{10}(d,p)B^{11} at E$_d$ = 1.25 MeV and E$_d$ = 4.6 MeV. The interpretation of the results is consistent with the value $\frac{3}{2}^-$ or $\frac{5}{2}^-$ for the total angular momentum and parity of the 4.46 MeV level in B^{11}.

539.17

17598 EXCHANGE EFFECTS IN STRIPPING REACTIONS.

M.A.Nagarajan and M.K.Banerjee.
Nuclear Phys., Vol. 17, No. 3, 341-58 (July (1), 1960).

The relative phases and amplitudes of the direct and exchange terms were calculated by taking anti-symmetrized wave-functions. Shell-model wave-functions were used for the nuclear wave-functions. Calculations of the angular distributions for the reactions Be^{9}(d, p)Be^{10}, F^{19}(d, p)F^{20} and O^{16}(d, p)O^{17} were carried out and these agreed well with the experimental angular distributions in these reactions. The interactions responsible for the knock-out reaction and the heavy-particle stripping reaction are discussed.

539.17

17599 NUCLEON EXCHANGE EFFECTS IN DEUTERON STRIPPING REACTIONS AND ANGULAR DISTRIBUTIONS OF Be^{9}(d,n)B^{10} REACTION.

K.Hasegawa and Y.H.Ichikawa.
Progr. theor. Phys., Vol. 21, No. 4, 569-80 (April, 1959).

Ordinary deuteron stripping theory has been extended to include the heavy-particle stripping process by antisymmetrizing a final-state wave-function with respect to an ejected nucleon and a target nucleon. A formalism presented by Owen and Madansky is inconsistent for discussing an interference effect between the ordinary deuteron stripping process and the heavy particle stripping proc
Experimental results of angular distributions of the Ne^{9}(d,n)B^{10} ground-state neutron are well reproduced by the present theory.

539

17600 INVESTIGATION OF THE ANGULAR DISTRIBUTIO OF TRITONS PRODUCED BY DEUTERONS OF ABO 0.9 MeV ON BERYLLIUM.

J.K.Mira and Z.N.Dragica.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 8, 17-22 (March, 1

The angular distribution of tritons from the reaction Be^{9}(d,t) and the triton yield compared with the yield of protons from Be^{9}(d,p)Be^{10} reaction were investigated at deuteron energies of 6 653, 697, 826, 869, 908, 920 and 993 keV. The incident energies were determined with an error of 3%.

539

17601 ELASTIC SCATTERING OF DEUTERONS ON Be^{9}.

M.K.Jurić and S.D.Ćirilov.
Bull Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 45-9 (March, 195

The angular distribution of the elastically scattered deuteron on Be^{9} was measured and compared with Rutherford scattering. anomalous scattering was found for the deuteron energies E$_d$ = 1 and 1.348 MeV, which indicates that there exist the resonant leve of the compound nucleus B^{11}.

539

17602 ANGULAR DISTRIBUTION OF PROTONS FROM C^{12}(d,p)C^{13} REACTION.

M.K.Jurić.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 35-9 (March, 19

This was measured for deuteron energies of 0.60, 0.80, 0.90, 1.000, 1.070, 1.200, 1.300 and 1.450 MeV, with a thin target. The coefficients of Legendre polynomials were calculated and given a function of energy.

539

17603 ANGULAR DISTRIBUTION OF PROTONS FROM O^{16}(d,p)O^{*17} REACTION.

M.K.Jurić.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 6, 41-4 (March, 19

The angular distribution of protons from this reaction (Q = 1.043 for the incident deuteron energies E$_d$ = 0.764, 0.800, 0.837, 0.981 1.047, 1.140, 1.160, 1.260 and 1.399 MeV, was investigated. The coefficients of Legendre polynomials were calculated for the mea ured angular distribution curves, and are given as the function o energy E$_d$. The total yields of O(d,p)O and O(d,p)O* reactions w compared and shown as functions of E$_d$.

539

17604 ANGULAR CORRELATION STUDY OF THE Mg^{24} (d, pγ) Mg^{25} STRIPPING REACTION AS A TEST OF T DISTORTED-WAVE THEORY.

J.P.Martin, K.S Quisenberry and C.A.Low, Jr.
Phys. Rev., Vol. 120, No. 2, 492-9 (Oct. 15, 1960).

Angular correlations between protons from the Mg^{24}(d,p) Mg reaction leading to the 3.40 MeV excited state of Mg^{25} and the resulting de-excitation gamma rays were investigated to test the validity of the distorted-wave stripping theory. A natural magnesium target was bombarded by 15 MeV deuterons and proton—gamma coincidences were counted using scintillation detectors in conjunction with conventional fast—slow coincidence circuitry. T correlations were studied at laboratory proton scattering angles of 15° and 45°, each in two mutually perpendicular planes: the reaction plane and the plane perpendicular to it containing the deuteron axis. The angular distribution of protons from this leve was also measured and fitted by a Butler stripping curve with $l_n = 1$ and $r_0 = 5.0$ fermis. The coordinate system used to descri the correlations is defined with the z axis in the $\vec{k}_d \times \vec{k}_p$ direction and the x-axis in the recoil nucleus direction. Correlation functi found by least-squares fits to the experimental data are, for the 15° proton angle,

$$W(k_d,k_p,\tfrac{1}{2}\pi,\phi) = 1 - (0.385 \pm 0.023)\cos^2(\phi-\phi_0),$$

with $\phi_0 = -27.7° \pm 2.9°$, and

$$W(\vec{k}_d,\vec{k}_p,\theta,\phi_r) = 1 + (0.145 \pm 0.029\ \cos^2\theta,$$

where ϕ_r is the beam direction. The functions found for the 45° proton angle are

$$W(\vec{k}_d,\vec{k}_p,\tfrac{1}{2}\pi,\phi) = 1 - (0.366 \pm 0.033)\cos^2(\phi-\phi_0),$$

$\phi_0 = -6.8^0 \pm 3.5^0$, and

$$W(k_d,k_p,\theta,\phi_r)\ \ 1 + (0.279 \pm 0.038)\cos^2\theta.$$

e observed correlations are in good agreement with the ctions of the distorted wave theory and not with those of the wave theory. It is to be noted in particular that the agree- is excellent at 45°, indicating that protons scattered at this probably arise from the stripping process in spite of the hat the disagreement between Butler stripping theory and the ured angular distribution is greatest here. This then suggests protons observed in the entire region beyond the first maximum ypical angular distribution are due to stripping and might be ately described by stripping theory if suitably distorted waves sed in the analysis.

539.17 : 539.14

7605 $Ti^{46,48}(d,p)Ti^{47,49}$ REACTIONS AND THE $1f_{7/2}{}^{n}$ AND $1f_{7/2}{}^{n-1}2p$ CONFIGURATIONS.

T.Rietjens, O.M.Bilaniuk and M.H.Macfarlane.
. Rev., Vol. 120, No. 2, 527-35 (Oct. 15, 1960).

The nuclide Ti^{47} was investigated via a high-resolution spectro- ic study of the reaction $Ti^{46}(d,p)Ti^{47}$. The observed levels, the sured orbital angular momenta of the captured neutrons, and entative total angular momenta assigned on the basis of rela- intensities were as follows: ground state, 0.16 MeV, $l_n = 3$, $\frac{7}{2}^-$; (0.55 MeV, $J^\pi = \frac{3}{2}^-$); 1.56 MeV, $l_n = 1$, ($J^\pi = \frac{3}{2}^-$); 1.80 MeV, 1, ($J^\pi = \frac{3}{2}^-$); 2.58 MeV, $l_n = 1$; 2.83 MeV, $l_n = 1$; 3.31 MeV, 1, ($J^\pi = \frac{1}{2}^-$ or $\frac{3}{2}^-$); 3.60 MeV, ($l_n = 1$, $J^\pi = \frac{1}{2}^-$); 3.71 MeV, ($l_n = 1$, $\frac{1}{2}^-$); and 3.95 MeV, ($l_n = 1$, $J^\pi = \frac{1}{2}^-$). Similarly for Ti^{49}: ground , $l_n = 3$, $J^\pi = \frac{7}{2}^-$; 1.38 MeV, $l_n = 1$, $J^\pi = \frac{3}{2}^-$; 1.72 MeV, $l_n = 1$, $\frac{3}{2}^-$); 2.44 MeV; 2.49 MeV; 3.17 MeV, ($l_n = 1$, $J^\pi = \frac{1}{2}^-$); and MeV, $l_n = 1$, ($J^\pi = \frac{1}{2}^-$). It is shown that the ground state of Ti^{49} the ground-state triplet of Ti^{47} can be accounted for by pure configurations, and that most of the observed levels can be ciated with $1f_{7/2}{}^{n-1}2p_{3/2}$ and $1f_{7/2}{}^{n-1}2p_{1/2}$ configurations.

539.17 : 539.16

$B^{10}(He^3,p)C^{12}$ REACTION : (p,γ,γ) COINCIDENCES.

Abstr. 17558

539.17

17606 THE ANOMALOUS INELASTIC SCATTERING OF ALPHA PARTICLES.

rut, D.R.Sweetman and N.S.Wall.
lear Phys., Vol. 17, No. 4, 655-83 (July (2), 1960).

Reports a series of experiments establishing and identifying the perties of the so-called anomalous states in medium-weight ei. These excitation energies for states are about 4 MeV for ei with $Z \leq 29$ and in the range of 2-3 MeV for nuclei with er Z. From a combination of angular distribution and correla- data it is shown (and interpreted by means of inelastic diffrac- scattering analysis) that the anomalous states in several cases consistent with the 3^- interpretation. This lends credence to r collective interpretation. The difficulties with such analyses discussed, and experimental matters are gone into in some il.

539.17

17607 ELASTIC AND INELASTIC SCATTERING OF 22 MeV ALPHA PARTICLES BY LIGHT ELEMENTS.

u, S.Kato, Y.Oda and M.Takeda.
hys. Soc. Japan, Vol. 14, No. 5, 549-54 (May, 1959).

The scattering of 22 MeV alpha particles from carbon, nesium and silicon has been studied with scintillation counter nique. The elastic scatterings from carbon and magnesium have wn the characteristic diffraction pattern, which can be obtained n the theory of diffraction by an opaque sphere. The observed astic angular distributions could be approximated by the squared erical Bessel function of second order as predicted by direct raction theory. The agreement is appreciably good for the ments studied. However, the cross-sections do not tend toward all values in the forward direction for magnesium and silicon.

539.17

17608 DIFFRACTION ANALYSIS OF ELASTIC AND INELASTIC SCATTERING BY MAGNESIUM.

.Blair, G.W.Farwell and D.K.McDaniels.
clear Phys., Vol. 17, No. 4, 641-54 (July (2), 1960).

Angular distributions for elastic scattering by Mg and inelastic attering proceeding to the 1.37 MeV 2^+ state in Mg^{24} were measured for alpha-particles of 41, 34 and 28 MeV incident energy and for deuterons of 21 MeV incident energy. These results as well as those obtained previously by other workers were analysed in terms of a diffraction-scattering model. This model predicts that the elastic and inelastic differential cross-sections, if divided by k^2, should each follow a single function of $2kR_0 \sin \frac{1}{2}\theta$ for all energies of the incident particles. Reasonable agreement between calculated and observed universal curves for alpha-particle scattering lends support to this model. Normalization of the experimental and theoretical universal curves for inelastic scattering leads to a value for the absolute magnitude of the equilibrium deformation parameter $|\beta_2|$ of 0.24.

539.17 : 539.14

17609 $Be^9(\alpha,n)C^{12}$ REACTION AND THE PARAMETERS OF THE 7.66 MeV STATE OF C^{12}.

F.Ajzenberg-Selove and P.H.Stelson.
Phys. Rev., Vol. 120, No. 2, 500-4 (Oct. 15, 1960).

The $Be^9(\alpha,n)C^{12}$ reaction was studied at $\bar{E}_\alpha = 5.6$ and 5.78 MeV. Neutron groups were observed to the first three states of C^{12}. The ratio of the population of the 4.43 and 7.66 MeV states was determined to be 8.1 ± 1 at $\bar{E}_\alpha = 5.6$ MeV. This value, together with information from a number of other sources, demonstrates that the 7.66 MeV state has $J^\pi = 0^+$; that its width for alpha emission is approximately the Wigner limit ($\Gamma \sim 8$ eV) and that in $\sim 10^{-3}$% of the cases the state decays to the ground state of C^{12} by pair emission. It is also estimated that the 7.66 MeV state can decay by γ-emission via the 2^+, 4.43 MeV state with a probability of 1/5000. This information reinforces the proposal that the 7.66 MeV state has the necessary properties to participate in the buildup of the elements in red giant stars.

539.17

17610 THE EXCHANGE TRANSFER REACTION $Al^{27}(N^{14},Mg^{27})O^{14}$. J.J.Pinajian.

Nuclear Phys., Vol. 17, No. 1, 44-53 (June (2), 1960).

The thick-target yield was measured for the reaction $Al^{27}(N^{14},Mg^{27})O^{14}$, which may be described as a simultaneous transfer of a neutron from one nucleus and a proton from the other. Mg^{27} was chemically separated and thick-target yields were measured by absolute γ-counting. A second aluminium foil behind the target was used to determine the amount of Mg^{27} produced by neutrons in the target. The ratio of front to back foil Mg^{27} yield was 1.54 : 1.00. Thick targets of ZnO were used to measure the yield of $O^{16}(N^{14},3p)Mg^{27}$. The cross-section at 27.6 MeV was found to be 110 μb. The yield of Mg^{27} in the 10 A oxide layer of the special aluminium foil targets was estimated to be 1.5% of the total yield. The thick-target yield of 9.45 min Mg^{27}, in aluminium, measured at 27.6 MeV incident energy, was found to be 13.6×10^{-12} per incident nitrogen ion after correction for neutron-induced Mg^{27}. The cross-section is estimated to be 2.2 ± 1.0 μb. Mg^{27} cannot be produced by the evaporation of light particles as in $Al^{27}(N^{14},3\alpha 2p)Mg^{27}$. Other possible mechanisms for the production of Mg^{27} are examined and their cross-sections are estimated.

539.17

17611 CLASSICAL ANALYSIS OF THE REACTION $Be^9(Li^7,Li^8)Be^8$. S.K.Allison.

Phys. Rev., Vol. 119, No. 6, 1975-81 (Sept. 15, 1960).

The mechanism of the reaction $Be^9(Li^7,Li^8)Be^8$, Q = 0.36 MeV, from which the angular distribution of Li^8 has been measured by Norbeck, Blair, Pinsonneault, and Gerbracht (NBPG) (Abstr. 4108 of 1960), is analysed from a classical viewpoint. The reaction is one of neutron pickup by the Li^7, and it is assumed that due to the low reaction energy and relatively low mass of the neutron the Li^7 and Be^9 are not unrecognizably perturbed from the classical hyperbolic orbits they would follow under Coulomb repulsion. For the NBPG data taken at 2 MeV Li^7 bombarding energy it is noted that the blurring of the classical trajectories due to diffraction is about 37% in the angle of deviation. Comparison of NPGB's cross-sections per steradian for Li^8 formation with those calculated from Rutherford's formula show that 1 in 10^6 passing Li^7 nuclei can capture a neutron from Be^9 in encounters in which the perinuclear distance is as great as $(3.0 \pm 0.55) \times 10^{-12}$ cm. The rate of radial attenuation of the probability of finding the Be^9 neutron in unit volume is determined from the angular distribution of Li^8, using the classical equation for the perinuclear separation as a function of angular deviation. In the region $(1.5 < r < 3) \times 10^{-12}$ cm it is consistent with the slope of the function $nr^{-2}\exp(-2\beta r)$ with $\beta = (2.1 \pm 0.5) \times 10^{12}$ cm^{-1}. The theoretical value for a neutron bound to a Be^8 structure by $W_n = 1.63$ MeV is $(2\mu W_n)^{1/2}/h$ or 2.6×10^{12} cm^{-1}. It is shown that the extraordinarily low (n,γ) cross-section for Li^7 determined by Imhoff, Vaughn, Johnson, and Walt cannot be used here to describe the capture. Using a plausible cross-section of 5×10^{-25} cm^2, the value of n in the specified region is 1.3×10^{13} cm^{-1}, giving, for instance, the absolute value of neutron probability per cm^3 at 2.0×10^{-12} cm radius as 6.2×10^{32} cm^{-3}. The function $nr^{-2}\exp(-2\beta r)$ must join on to one less steep at a radius $\geq 8 \times 10^{-13}$ cm, or the neutron probability integrated over all space becomes greater than unity.

539.17

17612 ELASTIC SCATTERING OF HEAVY IONS BY GOLD AND BISMUTH.

H.L.Reynolds, E.Goldberg and D.D.Kerlee.
Phys. Rev., Vol. 119, No. 6, 2009-16 (Sept. 15, 1960).

The angular distributions of C^{12}, N^{14}, O^{16} and Ne^{20} elastically scattered by Au^{197} and Bi^{209} were measured at laboratory energies of approximately 10.4 MeV per nucleon. The elastically scattered ions were recorded in photographic emulsions at laboratory angles from 19° to 175°. In general, measurements were extended only to angles where the ratio of the cross-section to the Coulomb cross-section, σ/σ_C, was greater than 0.1. In one case the measurement was extended to a region where $\sigma/\sigma_C \leq 1.4 \times 10^{-4}$. The cross-sections all exhibited a behaviour similar to that previously reported for C^{12} on Au^{197}. An oscillation in the cross-section ratio occurring at smaller angles than the 20 to 30% rise and sudden drop was observed. Excellent agreement was obtained with the Blair "sharp-cutoff" calculations for values of $\sigma/\sigma_C > 0.2$. Nuclear interaction distances calculated by fitting the sharp-cutoff calculations are consistent with $r_0 = 1.46$ fermis, where $R = r_0(A_1^{1/3} + A_2^{1/3})$. No striking distinction can be made regarding the surface characteristics of the four projectiles or the two targets.

539.17 : 539.14

17613 MEASUREMENTS OF ELASTIC SCATTERING OF 28 MeV ELECTRONS ON HEAVY NUCLEI.

J.B.Bellicard and P.Barreau.
Nuclear Phys., Vol. 17, No. 1, 141-52 (June (2), 1960). In French.

Reports measurements on 28 MeV electron scattering by gold and bismuth nuclei. Angular distributions of the scattered electrons were used to determine the root-mean-square radius of the charge distribution of the two nuclei with a precision of 2%. For the parameter r_0, entering into the expression for the radius $R = r_0 A^{1\ 3}$ of the homogeneous sphere adopted as charge distribution model, the values (in units of 10^{-13} cm)$r_0 = 1.17 \pm 0.02$ for gold, $r_0 = 1.15 \pm 0.03$ for bismuth were found. These results are in agreement with high-energy electron-scattering results.

539.17

17614 IMAGINARY PART OF THE DELBRÜCK SCATTERING AMPLITUDE. W.Zernik.

Phys. Rev., Vol. 120, No. 2, 549-51 (Oct. 15, 1960).

A method for computing the imaginary part of the Delbrück scattering amplitude, based on an expression derived by Kessler (Abstr. 4886 of 1959), has been developed and applied for gamma-ray energies of 2.62 and 6.14 MeV. The significance of the calculation with regard to available experimental results is discussed and some possible further developments are outlined.

539.17

17615 EFFECTS OF PHOTON POLARIZATION ON THE AZIMUTHAL ANGULAR DISTRIBUTION IN (γ, N) REACTIONS. A.G. de Pinho Filho.

Nuclear Phys., Vol. 18, No. 2, 271-9 (Aug.(2), 1960).

Some simple features are pointed out in the azimuthal angular distribution in photonuclear reactions induced by a partially plane-polarized photon beam. The use of such a beam is of special interest as a check of the electric dipole character of the photon absorption in the giant resonance region.

539.17

17616 PHOTONEUTRONS FROM BISMUTH. V.Emma, C.Milone, A.Rubbino and R.Malvano.

Nuovo Cimento, Vol. 17, No. 3, 365-74 (Aug. 1, 1960).

The energy spectrum of photoneutrons from bismuth irradiated with 31 MeV bremsstrahlung was studied at angles θ of 30°, 60°, 90°, 120° and 150°, by means of nuclear emulsion. A comparison between the experimental energy spectra and an evaporative spectrum calculated according the expression $F(E_n) = kE_n \exp[-E_n/T]$, shows a surprisingly high contribution of high energy neutrons around $\theta = 90°$. The angular distribution is isotropic in the region $(2 < E_n \leq 4)$ MeV, is approximately of the form $1 + 0.7\sin^2\theta$ for $(4 < E_n \leq 5)$ MeV, shows back and front asymmetry for $E_n > 5$ MeV. The contribut of the photoneutrons arising from the Bi(γ, 2n) process is evaluat

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17617 NUCLEAR PHOTO-REACTION AND EXCITATION MODES OF NUCLEI. S.Fujii.

Progr. theor. Phys., Vol. 21, No. 4, 511-32 (April, 1959).

By analysing the excitation functions given by experimental studies of the nuclear photoreaction, it is found that there are tw types of excitation mode of nuclei: the extra particle excitation the core excitation. Careful comparison of the predictions by th single particle model with experimental data shows that these tw types of excitation mode are distinguished in the photoreaction o light nuclei. It is indicated that the resonances observed in the (γ,n) reactions of C^{13}, N^{14} and F^{19}, and $N^{14}(\gamma,p)C^{13}$ in the energy region of 10-15 MeV are essentially due to the extra particle exc tion. In the case of medium weight and heavy nuclei the resonan due to the extra particle excitation should appear, in many cases at the energies lower than the thresholds for the (γ,n) or (γ.p) reactions. On the other hand, the giant resonance is characteriz by the core excitation mode. For the description of the core the possibility that the collective model may be preferable to the sin independent particle model is indicated. The distinction between these two models is discussed in detail.

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17618 TOTAL ABSORPTION OF γ-RAYS BETWEEN 10 AN 30 MeV IN LIGHT NUCLEI. B.Ziegler.

Nuclear Phys., Vol. 17, No. 2, 238-49 (June (3), 1960). In Germa

Absorption cross-sections in carbon, oxygen and aluminium were determined with a 32 MeV betatron and a magnetic pair spe trometer in the energy interval between 10 and 30 MeV. In this region, where the nuclear absorption is unimportant, the measur total electron absorption cross-section agrees within 1% with the theoretical value based on the theories of Klein and Nishina for t Compton effect, of Bethe and Heitler for the pair production in th field of the nucleus, and of Borsellino for the pair production in t field of the electron. The total nuclear absorption shows the gian resonance peak well known in photonuclear reactions. The peak cross-section was found to be 18 mb at 22.5 MeV for carbon, and 50 mb at 20 MeV for Al. The oxygen and aluminium data suggest smoothly varying nuclear absorption cross-section.

539

17619 RELATIVE ESCAPE AND ENERGY DISTRIBUTION O PHOTO-DEUTERONS FROM COPPER.

A.P.Komar, E.D.Makhnovskii and V.P.Poddubnov.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 797-9 (Aug. 1, 1960).
In Russian.

The experiment was carried out in vacuum, in a magnetic fie and particles were registered in a nuclear emulsion. Particles were distinguished by momentum and track length in a novel way. Results are presented for angles from 20° to 50°. For energies from 4 to 10 MeV, the ratio of deuterons to protons was 0.078 ± 0. The deuteron energy distribution has its maximum below 4 MeV.

D.W.L.Spru

539

17620 THE GAMMA—NEUTRON CROSS SECTION FOR F^{19}. J.D.King, R.N.H.Haslam and W.J.McDonald.

Canad. J. Phys., Vol. 38, No. 8, 1069-76 (Aug., 1960).

The $F^{19}(\gamma,n)F^{18}$ reaction has been studied by irradiating teflo samples in the X-ray beam of a 25 MeV betatron and detecting th annihilation radiation emitted during the decay of the residual nuclei. The cross-section shows maxima at 10.6 (very small), 12.4, 14.0, 16.1, 17.2, and 19.3 MeV. The peak at 12.4 MeV is possibly due to excitation of the last neutron in F^{19} with only a small disturbance of the core nucleons. The peaks at 14.0 and 19.1 MeV are interpreted as the components of a split giant reson ance, indicating an intrinsic quadrupole moment, Q_0, of approximately 0.30×10^{-24} cm^2 for F^{19}.

539.17 : 539

17621 RESONANT SCATTERING OF X-RAYS FROM MAGNESIUM AND SILICON. R.A.Tobin.

Phys. Rev., Vol. 120, No. 1, 175-80 (Oct. 1, 1960).

Energy levels at 10.15 ± 0.06 MeV in magnesium and 11.40 ± 0.06 MeV in silicon were studied using resonant scatterin from a continuous spectrum of X-rays by samples of these mater

g tentative spin assignments and assuming no branching, level
s of 4.80 (+1.6, −1.4) eV and 2.89 (+1.0, −0.8) eV for magne-
and silicon, respectively, have been determined from absorp-
measurements.

539.17

17622 NEUTRON STRENGTH FUNCTION $\bar{\Gamma}_n^0/D$ WITH COMPLEX DIFFUSE BOUNDARY POTENTIAL.

A.Ghosh.

n J. Phys., Vol. 33, No. 9, 395-400 (Sept., 1959).

The strength function $\bar{\Gamma}_n{}^0/D$ which is the average value of
ron width to level spacing and the effective radius R' are
lated with a complex spherical well having a diffuse boundary.
values of the parameters involved in the potential function are
by comparing the curves for the strength function with those
by Weisskopf. The S-state energy eigenvalues calculated with
bove parameters are in agreement with similar calculations
reen and Lee (Abstr. 8992 of 1955).

539.17

17623 NEUTRON TOTAL CROSS SECTIONS IN THE 17 TO 29 MeV REGION.

.Peterson, A.Bratenahl and J.P.Stoering.

s. Rev., Vol. 120, No. 2, 521-6 (Oct. 15, 1960).

The neutron total cross-sections of 42 elements and isotopes
e measured at several energies between 17 and 29 MeV using
oenergetic neutrons produced by the Livermore variable-energy
lotron through the $T(d,n)He^4$ reaction. Beam contaminations by
ma-rays and low-energy "breakup" neutrons were measured
ime-of-flight techniques, and their effects were kept small by
ably high bias on the plastic scintillator detector. The accuracy
ross-section is typically ±1 to 2%. The data in this energy
ion have been sparse heretofore. Where comparisons with pre-
s data have been possible, there is substantial agreement.
en plotted versus energy and mass number, the data form a
oth cross-section surface which joins on smoothly to the data
ow energies. The data seem in good agreement with the predic-
s of the optical model of Bjorklund and Fernbach (Abstr. 8978
958).

539.17

17624 RADIATIVE CAPTURE CROSS SECTIONS FOR FAST NEUTRONS.

.Diven, J.Terrell and A.Hemmendinger.

s. Rev., Vol. 120, No. 2, 556-69 (Oct. 15, 1960).

Neutron capture cross-sections were measured for 28 elements
he neutron energy range 175 to 1000 MeV. The method used was
ection of capture gamma radiation in a 1 metre diameter liquid
ntillator, the capture samples being placed at the centre for
adiation by a pulsed neutron beam. Absolute cross-sections were
ermined by comparison with the known capture-plus-fission
ss-section of U^{235}; both capture and fission events were detected
h nearly 100% efficiency in this arrangement. Corrections were
de for loss of capture-gamma-ray energy, by means of pulse
ght analyses and comparison between 1 metre and 48 cm scintil-
or results; correction were also made for change in path length
to scattering. The results obtained appear to agree reasonably
ll with the predictions of resonance theory, with level densities
en by the Fermi gas model together with the effective ground
te of Hurwitz and Bethe. The low capture cross-sections of
gic-number target nuclides appear well correlated with the
gic-number effects on the mass.

539.17

17625 TOTAL EFFECTIVE NEUTRON CROSS-SECTION OF ARSENIC IN THE ENERGY RANGE FROM 0.01 TO eV.

D.Dragomiresku, S.Apostolesku, V.Mateichuk and M.Beshliu.

v. de Physique (Bucharest), Vol. 5, No. 1, 99-102 (1960).
Russian.

The measurements were made using a crystal spectrometer,
ich is described in detail. The low-energy data were found to be
scribed by: $\sigma = 3.75 + 0.966\ E^{-1/2}$ (barns). The extrapolated
lue for the total cross-section at 0.0253 eV is 9.83 ± 1.14 barns.
th improved equipment, it is hoped to improve the accuracy of the
sults.

J.H.Gunn

539.17

17626 TOTAL NEUTRON CROSS-SECTION OF B^{10} IN THE THERMAL NEUTRON ENERGY RANGE.

.W.Schmitt, R.C.Block and R.L.Bailey.

uclear Phys., Vol. 17, No. 1, 109-15 (June (2), 1960).

A precise determination of the total neutron cross-section of
^{10} was made by means of transmission measurements of boron samples highly enriched in B^{10}. The ORNL fast chopper time-of-flight spectrometer was used to obtain results in the neutron energy range $0.018 \leq E \leq 0.4$ eV. It was found that the total cross-section of B^{10} in this energy range follows the relation $\sigma_t(b) = (612 \pm 6)/\sqrt{E(eV)}$. The total cross-section of B^{10} for neutrons of energy 0.0253 eV (velocity = 2200 m/sec) was found to be 3848 ± 38 barns.

539.17

17627 $Be^9(n,2n)Be^8$ AND $B^{11}(n,\alpha)Li^8(\beta)Be^8$ REACTIONS BY 14 MeV NEUTRONS.

M.Sakisaka.

J. Phys. Soc. Japan, Vol. 14, No. 5, 554-63 (May, 1959).

$Be^9(n,2n)Be^8$ and $B^{11}(n,\alpha)Li^8(\beta)Be^8$ reactions induced by 14 MeV neutrons were studied by the method of beryllium and boron loaded nuclear emulsions. In the former reaction, the angular distributions of Be^8 nuclei were strongly peaked backward in the centre-of-mass system, suggesting that the direct interaction of the incident neutrons with beryllium — an inelastic scattering process before second neutron emission and a pick-up process probably — had a major contribution to the reaction. The cross sections were measured as 0.18 ± 0.07, 0.03 ± 0.02, 0.11 ± 0.04 and 0.05 ± 0.03 barns for the 3, 5, 7.5 and > 9 MeV excited states of Be^8 respectively. When 0.17 ± 0.03 barns was cited to the cross-section with respect to its ground state, the total (n,2n) cross-section was estimated as 0.54 ± 0.09 barns. The cross-section of the latter reaction was measured as 35 ± 7 millibarns in which the contribution of Be^8 in the ground state was not included. Most Li^8 nuclei were found to be left at the states lower than 2.5 MeV in the reaction. The decay rates of Li^8 to the Be^8 states of 3, 5 and > 8 MeV were about 75, 15 and 10% respectively and the mixing of the allowed transitions of such rates was consistent with the known β-spectrum of Li^8.

539.17

17628 DIRECT-INTERACTION EJECTION IN THE $Be^9(n, 2n)Be^8$ REACTION.

R.Balian and V.P.Gillet.

Nuclear Phys., Vol. 17, No. 3, 448-67 (July (1), 1960). In French.

Methods of direct interaction are applied to the study of ejection reactions, which end in a 3-particle channel. General expressions for cross-sections are given. Application is made to the reaction $Be^9(n, 2n)Be^8$ up to 14 MeV, for which the contribution of the ejection process must be important, due to the low binding energy of the last nucleon of Be^9. Energies of 0.5 and 5 MeV for outgoing neutrons are found to be favoured. Contributions of various regions of interaction are analysed separately, and the reaction is found to take place mainly outside the core of Be^9. The cross-section, calculated through ejection mechanism, together with compound nucleus results for low energy, agrees well with experimental data, If a break-up process is considered instead of the compound one, the agreement is less satisfactory.

539.17

17629 AUTOMATIC-RECORDING APPARATUS FOR FISSION-FRAGMENT TIME-OF-FLIGHT MEASUREMENTS.

J.S.Fraser and J.C.D.Milton.

Nuclear Instrum., Vol. 2, No. 3, 275-81 (April, 1958).

An apparatus has been constructed to measure the velocities of both members of a fission-fragment pair. A zero-time signal is obtained at the expense of about one per cent of the fragment energy by detecting delta rays ejected by the fragment from a thin plastic foil placed near the source. The fragment times of flight are converted to pulse heights for analysis. An overall time resolution of 3.5 mμsec is obtained. A third variable, e.g. gamma-ray energy or prompt neutron time of flight, may also be recorded, the three pulse heights being punched consecutively on paper tape. Three-dimensional analysis is therefore possible but in practice sorting is done taking two variables at a time.

539.17 : 539.14

17630 INDIVIDUAL STATES AT THE FISSION THRESHOLD.

M.Demeur, P.Janssens and J.Lardinois.

Nuclear Phys., Vol. 18, No. 2, 280-5 (Aug. (2), 1960). In French.

A dumb-bell potential is quantized in order to find the properties of individual levels in a nucleus near the fission threshold.

539.17

17631 ANGULAR DISTRIBUTIONS OF NUCLEAR FISSION IN THE RESONANCE RANGE.

O.Hittmair.

Nuclear Phys., Vol. 18, No. 2, 346-52 (Aug. (2), 1960). In German.

An expression for the angular distribution of resonance fission is developed under the condition that the nucleus preserves its axial symmetry in the process of fission. This is achieved by reducing the representation product which describes the orientation of the nuclear symmetry axis in space with respect to the entrance channel. The result is expressed in Racah coefficients and Legendre polynomials. General predictions about the symmetry of the angular distribution and the effect of polarized incident neutrons can be made. The formula is applied to the resonance fission of Th^{232} for incident 1.60 MeV neutrons, adopting the unified model. Excellent agreement with experiment is obtained if the resonance is ascribed to rotational levels of the $\frac{3}{2}$-band of negative parity.

539.17

17632 FISSION OF RADIUM BY 11 TO 22 MeV PROTONS.
R.L.Wolke.
Phys. Rev., Vol. 120, No. 2, 543-8 (Oct. 15, 1960).

The ranges and relative yields of Sr^{91} and Pd^{112} fragments from the fission of Ra^{226} by 11 to 22 MeV protons were determined by a radiochemical recoil-catching technique. The relative yield data indicate that above 11 MeV the three-humped mass-yield curve becomes predominantly "symmetric" and perhaps somewhat narrower. An apparent fission threshold of ~10.4 MeV was observed. The curve of total fission yield versus energy has the same slope between 13 and 22 MeV as has been reported for the fast-neutron-induced fission of radium. The ranges in mg Au/cm^2 at 11 and 20 MeV, respectively, are, Sr^{91}: 11.2 ± 0.9 and 10.8 ± 0.2; Pd^{112}: 9.1 ± 1.0 and 9.2 ± 0.3, corresponding to an average total kinetic energy of 162 ± 10 MeV.

539.17

17633 PHOTOFISSION IN FISSION CHAMBERS.
R.N.Glover,.
Nuclear Instrum., Vol. 3, No. 6, 320-2 (Dec., 1958).

During shielding measurements in water on LIDO a large discrepancy was observed between fast neutron flux measurements with fission chambers and those using activation techniques. This effect is shown to be due to photofission of the fissionable material in the chambers.

539.17

17634 RATIO OF ASYMMETRIC TO SYMMETRIC FISSION OF Pu^{239} AND Pu^{241} AS A FUNCTION OF NEUTRON ENERGY.
R.B.Regier, W.H.Burgus, R.L.Tromp and B.H.Sorensen.
Phys. Rev., Vol. 119, No. 6, 2017-20 (Sept. 15, 1960).

For previous work, see Abstr. 8648 of 1959. Further radiochemical experiments were carried out to test the theoretical suggestion that in low-energy neutron-induced fission, the asymmetric to symmetric fission ratio should depend on the spin of the fissioning nucleus. In the present work two kinds of experiments were done. In the first, with both Pu^{239} and Pu^{241}, comparisons were made of the asymmetric/symmetric yield ratios for thermal fission with the corresponding ratios for gross resonance fission with epi-Sm neutrons. In the second kind, monoenergetic neutrons were employed to study variations of Pu^{239} fission yields with neutron energy over the 0.297 eV resonance. If the assumption is made that spin difference is the principal cause of change in the asymmetric/symmetric ratio in this energy region, the results indicate that this ratio differs by a factor of at least 5.3 between the two spin states of Pu^{239}. This is the largest effect of this kind observed to date.

539.17

17635 ANGULAR DISTRIBUTION OF FRAGMENTS IN FISSION INDUCED BY MeV NEUTRONS.
J.E.Simmons and R.L.Henkel.
Phys. Rev., Vol. 120, No. 1, 198-210 (Oct. 1, 1960).

A multiangle gas-filled counter was used to measure the fragment angular distribution in fission induced by neutrons in the energy range $0.5 \le E_N \le 9$ MeV. The target nuclei used were: Th^{230}, U^{233}, U^{234}, U^{235}, U^{236}, U^{238}, Np^{237}, and Pu^{239}. In the cases of U^{233} and U^{235} the neutron energy range was extended to include energies between 14.8 and 23 MeV. The general features of these data are as follows. The anisotropy — $(0^\circ/90^\circ)$ intensity ratio — has values between 1.1 and 1.2 depending on the target and is roughly independent of energy for E_N between 2 and 5.5 MeV. At higher energies a rise is observed such that at 7 MeV even—odd targets gives values of anisotropy in the range 1.2 to 1.3 while even—even targets show greater values in the range 1.6 to 2.2. The anisotropy decreases somewhat by 9 MeV. Near thresholds for the even—even target nuclides considerable fluctuations of anisotropy are observed. The example of U^{236} at 0.85 MeV shows a new case of minimum intensity at 0°, the anisotropy being 0.64. In the energy region 2-4 MeV, the anisotropy of Pu^{239}, U^{233}, and U^{235} increases by a few percent from one to the next as the spin increases. This is contrary to simple theoretical expectations. The data are compared to recent theoretical developments of the Bohr model as given by Griffin and by Halpern and Strutinski. The theory provides a satis factory account of many features of the data.

539.

17636 THE FISSION OF GOLD BY OXYGEN NUCLEI.
A.R.Quinton, H.C.Britt, W.J.Knox and C.E.Anderson.
Nuclear Phys., Vol. 17, No. 1, 74-88 (June (2), 1960).

The angular distribution and the energies of the fission fragm emitted in the bombardment of a thin gold foil by 160 MeV oxygen nuclei, were experimentally determined by the use of a proportion counter detector. By a comparison with the theory of Halpern and Strutinski an estimate was made of the shape of the fissioning nucleus at the saddle point. The total kinetic energy released was determined to be 150 MeV. It is claimed that the fissioning nucleu has typically a mass of 204 mass units. The possibility of the emission of charged particles, as well as neutrons, in some of the evaporation chains preceding fission, is discussed. A fission cros section of 1.8 ± 0.2 b was obtained.

539.1

17637 ON THE TIME VARIATION IN THERMONUCLEAR FUSION SYSTEMS.
S.Fujii, M.Imoto and G.Tominaga.
Progr. theor. Phys., Vol. 21, No. 5, 758-9 (May, 1959).

The time variation of fusion systems are studied by analogy to astrophysical results, in particular with respect to energy balance of the reaction. Two types of energy balance are considered, the instantaneous and the integrated balances between energy generation and energy loss. Solutions of the basic equations are given whic are dependent on the parameter τ, the product of the ion density a the time. J.W.Sturges

539.17 : 537.5

17638 A COMPILATION OF SOME RATES AND CROSS SECTIONS OF INTEREST IN CONTROLLED THERMONUCLEAR RESEARCH.
C.F.Wandel, T.Hesselberg Jensen and O.Kofoed-Hansen.
Nuclear Instrum. and Methods, Vol. 4, No. 5, 249-60 (June, 1959).

A compilation has been made of cross-sections and corresponding time rates, of interest for calculations in the controlled thermonuclear field. The compilation is limited to phenomena occurring in fully ionized plasmas. It includes the relevant cross-sections for nuclear reactions, Coulomb collisions and bremsstrah lung radiation. Characteristic time rates for the above phenomena are given assuming Maxwellian velocity distributions for the particles involved.

539.17 : 539.12

17639 DETECTION OF HEAVY PARTICLES IN THERMONUCLEAR REACTION EXPERIMENTS.
L.H.T.Rietjens and C.M.Braams.
Nuclear Instrum and Methods, Vol. 4, No. 5, 363-6 (June, 1959).

A survey is given of methods for detection of heavy particles resulting from thermonuclear reaction experiments. Measurements of neutron emission as a function of time and energy are discussed in detail.

539.17 : 539.1

HEAVY ISOTOPE ABUNDANCES IN MIKE THERMONUCLEAR DEVICE. See Abstr. 17512

NUCLEAR POWER STUDIES

539.17

17640 SOME MATHEMATICAL PROBLEMS OF NUCLEAR REACTOR THEORY.
G.Birkhoff.
Frontiers of numerical mathematics symposium, Wisconsin, 1959 (see Abstr. 12232 of 1960), Paper Two, p. 23-39.

The physical side of reactor neutronics is surveyed and most of the standard mathematical techniques are briefly discussed, including transport theory, multigroup theory, age theory, Carlson method, spherical harmonics method, Monte Carlo methods. The emphasis is on steady-state processes, but dynamical problems are briefly mentioned. H.N.V.Temperley

539.17

7641 THE "CONSORT" REACTOR FOR TRAINING AND RESEARCH. K.Hart and C.G.James.

C. atomic Energy Rev., Vol. 2, No. 3, 118-28 (Spring, 1960).

Gives a comprehensive description of a new reactor designed ly by G.E.C. and Imperial College, London, especially for train- nd research use in universities and colleges. The reactor com- s the advantages of the "swimming-pool" and "enclosed-tank" s, giving ease of fuel handling together with compactness and accessibility for experimental facilities. The basic design is ly adapted to meet specialist needs; standard M.T.R.-type fuel ents are used.

539.17

7642 APPLICATION OF THE TWO-PARAMETER DIAGRAM TO THE STUDY OF THE STABILITY OF NUCLEAR CTORS. A.Blaquière.

. Acad. Sci. (Paris), Vol. 250, No. 20, 3316-17 (May 16, 1960). 'rench.

An extension of the Nyquist theory to nonlinear systems which lves two parameters represented in a complex plane is appli- le to oscillations in power reactors. Bethe's theory (APDA ort 117, Oct., 1956) follows from the theory. C.G.Morgan

539.17

17643 THE INFLUENCE OF RADIOACTIVE DECAY ENERGY OF FISSION PRODUCTS ON THE AUTOMATIC NTROL OF NUCLEAR POWER PLANTS. E Laurila.

. Acad. Sci. Fennicae A VI, No. 30, 7 pp. (1959).

A simple transfer function representation for radioactive beta- gamma-decay power in reactors is described. The role of this ver appears to be of little importance in automatic control blems.

539.17

17644 THE HETEROGENEOUS THEORY OF CYLINDRICAL NEUTRON MULTIPLYING STRUCTURES. S.E.Corno.

ovo Cimento, Vol. 17, No. 4, 580-98 (Aug. 16, 1960).

The critical equation together with the stationary thermal utron distribution is stated for a cylindrical neutron-multiplying ructure. The fissionable material is assumed to be lumped into veral blocks; allowance is made for an arbitrary distribution of em in the system. The source-sink technique is used throughout, ile the neutron migration is dealt with by age-diffusion or multi- oup approximations. Leakage and non-leakage probabilities as function of the neutron birth position are carefully computed. A ethod is worked out for the simultaneous evaluation of the iticality, together with the maxima and mimina of any function of e critical mass itself.

539.17 : 537.56

17645 FUSION EXPERIMENTS IN DEUTERIUM PLASMA. S.Berglung, R.Nilsson, P.Ohlin, K.Siegbahn, T.Sundström, d S.Svennerstedt.

clear Instrum., Vol. 1, No. 5, 233-41 (Sept., 1957).

An experimental set-up for studying fusion reactions and other tures of a hot plasma is described. A low inductance condenser nk of $60\,\mu$F has been used and high current discharges in uterium through straight tubes have been studied. The neutron oduction was found to be rather critically dependent on many ctors. Two new phenomena have been observed: neutrons may pear in the first pinch, and a high frequency oscillation in the sma may occasionally be excited just after the pinch has been med with a subsequent strongly enhanced emission of neutrons.

ATOMS

539.18

17646 AN ANALYTICAL FORMULA IN THE THEORY OF THE FORMATION OF THE ELECTRONIC SHELLS IN THE RIODIC SYSTEM OF ELEMENTS. T.Tietz.

ta phys. Hungar., Vol. 9, No. 1-2, 73-7 (1958). In German.

An analytic approximate expression of a formula of Fermi ing the lowest atomic number at which occupation of the s, p, d ... ells starts. L.Pincherle

539.18

17647 THOMAS–FERMI–DIRAC THEORY WITH CORRELATION CORRECTION. Y.Tomishima.

Progr. theor. Phys., Vol. 22, No. 1, 1-11 (July, 1959).

Using the formula of the correlation energy due to Pines, the Thomas–Fermi–Dirac model with the Fermi–Amaldi correction for a free atom or ion is modified to include correlations between electrons. By use of the model, electron distributions for free Rb$^+$, Kr and Br$^-$ are calculated; the results are shown graphically, and the energy components of the total energy are given numerically.

539.18

17648 ON THE CORRELATION CORRECTION TO THE FERMI–THOMAS–DIRAC EQUATION. H.Payne.

J. chem. Phys., Vol. 32, No. 5, 1589-90 (May, 1960).

Using two simplified relations for the correlation energy of an atom it is possible by suitable manipulation to use existing tables of solutions to the FTD equation. Calculation of the atomic radii indicates that the method gives limiting values for atomic properties but the method fails for positive ions. R.A.Ballinger

539.18

17649 RITZ–HYLLERAAS SOLUTIONS OF THE GROUND STATE OF TWO-ELECTRON ATOMS INVOLVING FRACTIONAL POWERS. H.M.Schwartz.

Phys. Rev., Vol. 120, No. 2, 483-7 (Oct. 15, 1960).

For previous work, see Abstr. 6857 of 1956. Earlier work on the inclusion of half-integral powers in the Ritz–Hylleraas ground-state solutions of the nonrelativistic wave equation for the helium atom is extended through functions involving 18 parameters. Energies that are lower than those found with other published comparable functions are obtained in all cases. Preliminary results are also given of calculations involving more general fractional powers, Z values different from 2, and half-integral-power solutions for which the expectation value of the square of the Hamiltonian is finite. With the latter type of expansions one obtains, at least at an early stage, an additional improvement in the approximation. Thus, with 11 parameters one finds the energy −2.903704 atomic units, which differs by only 0.0007% from the 80-parameter solution of Kinoshita. The initial results found for Z = 8 indicate an improvement in convergence over that obtained for Z = 2; the energy −59.156560 atomic units, which was obtained with a 12-parameter function, was only 0.00006% larger than the energy obtained by Pekeris with his 210-term function. The computed mass polarization corrections give also satisfactory results as judged by the similar results obtained with the most extensive solutions available.

539.18

17650 SECOND-ORDER PERTURBATION ENERGY OF THE TWO-ELECTRON ATOM. C.W.Scherr.

J. chem. Phys., Vol. 33, No. 1, 317-18 (July, 1960).

A calculation has been made using hydrogenlike wave-functions of the contribution to ϵ_2 from the terms corresponding to doubly bound states, to singly ionized states made up from wave-functions with $l = 0,1$ and to doubly ionized states using $l = 0$. R.A.Ballinger

539.18

17651 ELECTRONIC CORRELATION ENERGY IN 3- AND 4-ELECTRON ATOMS. J.Linderberg and H.Shull.

J. molecular Spectrosc., Vol. 5, No. 1, 1-16 (July, 1960).

The electronic correlation energy in 3- and 4-electron atomic systems is compared to previously well-established correlation energies in 2-electron atoms. It is shown that the distribution of correlation energy in the K shell of these atoms between radial and angular correlation parallels that of the 2-electron system very closely. It is found, however, that the correlation in the L shell of the Be ground state is almost purely angular correlation energy. There is negligible correlation energy associated with K–L interaction. Analysis of the Z dependence of the correlation energy of 4-electron atoms shows a term linear in Z. It is suggested that this term arises from degeneracies existing in the limit of infinite Z, and a tabulation of states expected to have this property is given. The analysis suggests a convenient scheme for constructing a semiempirical method for estimating atomic energies rather accurately. It is pointed out that a similar analysis for molecules in terms of the internuclear parameters suggests there may be inherent difficulties in constructing such a scheme for the molecular case.

539.18

17652 DERIVATION OF THE WAVE FUNCTIONS FOR $j = 1 + \frac{1}{2}$, $j = 1 - \frac{1}{2}$ STATES AND FOR "0" SPIN USING KAR'S LINEAR HAMILTONIAN. S.Purkayastha.

Indian J. theor. Phys., Vol. 6, No. 4, 97-106 (Dec., 1958).

Exact wave-functions representing the two components of the energy levels due to spin, are obtained in directly from the second order R-equation. The wave equation of a particle with zero spin is also deduced starting from Kar's linear Hamiltonian.

539.18 : 539.19 : 539.12

GROUND STATE OF SYSTEMS OF THREE PARTICLES WITH COULOMB INTERACTION. See Abstr. 17806

539.18 : 539.19

SELF-CONSISTENT FIELD ATOMIC AND MOLECULAR ORBITALS AND THEIR APPROXIMATIONS AS LINEAR COMBINATIONS OF SLATER-TYPE ORBITALS. See Abstr. 17814

539.18 : 539.2

ON THE NUMBER OF 3d-ELECTRONS IN THE TRANSITION METALS. See Abstr. 15828

539.18 : 539.19

ANALYTICAL SELF-CONSISTENT FIELD FUNCTIONS FOR THE ATOMIC CONFIGURATIONS $1s^2$, $1s^22s$ AND $1s^22s^2$. See Abstr. 17808

539.18 : 539.19

SOME RECENT ADVANCES IN DENSITY MATRIX THEORY. See Abstr. 17833

539.18 : 539.19

RELATIVISTIC CORRECTIONS IN MANY-ELECTRON SYSTEMS. See Abstr. 17830

539.18

17653 THEORETICAL AND EXPERIMENTAL STUDY OF SEVERAL-QUANTA TRANSITIONS BETWEEN ZEEMAN SUBLEVELS OF AN ATOM. J.M.Winter.

J. Phys. Radium, Vol. 19, No. 11, 802-5 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Recent experiments have shown that magnetic dipole transitions are observed, in which the selection rule $\Delta m = \pm 1\ 0$ is not followed. Transitions induced by a magnetic oscillating field H_1 have been studied in the following hypotheses. (a) H_1 is a rotating field, perpendicular to H_0, a transition is obtained whenever $E_m - E_{m'} = h\omega(m - m')$, $m - m' = 0, \pm 1, \pm 2$, etc... (b) H_1 is elliptical (the plane of the ellipse being arbitrary). In the case of a 2 level system ($J = 1/2$), resonances are observed whenever $E_{1/2} - E_{-1/2} = p.\hbar\omega$ p, any integer. There is, of course, conservation of energy and of angular momentum in these transitions. (c) 2 oscillating fields are present ω and ω'. In the case $J = 1/2$, there is resonance when $E_{1/2} - E_{-1/2} = \hbar(p\omega + q\omega')$, p, q, positive or negative integers. In each case, energy displacements, line widths and line intensities have been computed as a function of H_1. All the above predictions have been observed experimentally, on Na atoms, using optical pumping and optical selection. The buffer gas was argon at 0.3 mm. It was verified that line displacements were a linear function of H_1^2, whereas line widths are linear functions of H_1^p for a p quanta line. The ultimate width of the lines at low r.f. levels was of the order of 200 cycles.

539.18

17654 LOWER BOUNDS FOR EIGENVALUES WITH APPLICATION TO THE HELIUM ATOM. N.W.Bazley.

Phys. Rev., Vol. 120, No. 1, 144-9 (Oct. 1, 1960).

A method is derived for finding lower bounds to the energy levels of the Schrödinger equation. This method is applied to the helium atom. The best lower bounds thus obtained are -3.063_7 and -2.165_5 atomic units for the energies $E(1\,^1S)$ and $E(2\,^1S)$, respectively. If this lower bound for $E(2\,^1S)$ is used together with the best published values of $\langle H\psi,\psi\rangle$ and $\langle H\psi,H\psi\rangle$ of the ground state, a rigorous lower bound -2.9037474 atomic units is found for $E(1\,^1S)$.

539.18

17655 HELIUM WAVE FUNCTION IN MOMENTUM SPACE. M.G.Henderson and C.W.Scherr.

Phys. Rev., Vol. 120, No. 1, 150-2 (Oct. 1, 1960).

Approximate solutions to the integral Schrödinger equation in momentum space are obtained. The iteration scheme of Svartholm (1945) is used to obtain the first iterated wave-function and the half-iterated energy. A wave-function of the type

$$\phi = \Sigma\, C_{ij}[\exp(-\alpha_i p_1^2 - \alpha_j p_2^2) + \exp(-\alpha_j p_1^2 - \alpha_i p_2^2)]$$

is employed to start the iteration procedure. The best energy va computed using a wave-function with three nonlinear parameters -2.8915 atomic units. This energy is to be compared with the result of a conventional variational calculation using the same w function in coordinate space, -2.85112 atomic units.

539

17656 R.F. RESONANCES OF THE $n = 4$ LEVEL OF A SINGL IONIZED HELIUM ATOM. G.W.Series and W.N.Fox

J. Phys. Radium, Vol. 19, No. 11, 850-3 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Electric dipole transitions between the magnetic states of the lev $4S_{1/2}$, $4P_{1/2}$ of singly ionized helium were studied, with a view to measuring the Lamb shift. The excited ions are produced in a gl discharge, resonances being detected by changes in intensity of t line λ 4686, which arises from the optical transition $n = 4 \rightarrow n$ 3 A tuned cavity resonating at about 2000 Mc/s is used, the electri dipole resonances being swept through by varying a magnetic fiel

539.18 : 53

EXPANSION THEOREM FOR THE TOTAL WAVE FUNCTIO AND EXTENDED HARTREE—FOCK SCHEMES. See Abstr. 178

539

17657 IRON SERIES HARTREE—FOCK CALCULATIONS. II R.E.Watson.

Phys. Rev., Vol. 119, No. 6, 1934-9 (Sept. 15, 1960).

For Pt I, see Abstr. 9737 of 1960. Analytic Hartree—Fock calculations have been carried out for the lowest neutral atom $3d^{n-2}4s^2$ states of Ti through Zn. Except for Cr and Cu, these ca lations are for the neutral atom ground states. The results are c pared with the earlier $3d^n$ state calculations. It is observed that 4s electrons have little effect on the 3d and inner shells.

539

17658 SOME REMARKS ON THE ELECTRON AFFINITY OF ATOMIC LITHIUM. E.Holøien.

J. chem. Phys., Vol. 33, No. 1, 309-10 (July, 1960).

Previous semiempirical calculations of the electron affinity have been reinvestigated in the light of a recent new theoretical result. Before extrapolating, experimental results are checked for smoothness and corrected where necessary. The results obta ed are in very good agreement with the theoretical value.

R.A.Ballin

539

17659 MAGNETIC RESONANCE LINE WIDTH OF THE 6 ^{3}P STATE OF MERCURY AND MULTIPLE SCATTERIN OF 2537 A PHOTONS. J.P.Barrat.

J. Phys. Radium, Vol. 19, No. 11, 858-62 (Nov., 1958). In Frenc

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Several methods used to measure the lifetime τ of the 6 $^3P_1$ state of mercury (double resonance and Hanle's method), lead, in fact, to a "coherence time" T, longer than τ, and equal to τ at very lo vapour pressures. This effect is due to imprisonment of 2537 optical resonance radiation. It happens in a completely independ way for the different hyperfine components of the 2537 line. The same effect is responsible for the depolarization of the 2537 line at high vapour pressures. The theory gives relations between T and the degree of polarization of a given hyperfine component; an the relations between the T's of the different isotopes. It gives a the theoretical shape of the magnetic resonance lines when optica resonance photons have been scattered only twice. Experimental results are in good agreement with theory.

53

17660 OPTICAL DETECTION OF THE NUCLEAR MAGNET RESONANCE OF Hg^{201}. B.Cagnac.

J. Phys. Radium, Vol. 19, No. 11, 863-5 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Optical pumping and optical detection have been used extensively in the study of magnetic resonance of alkali metals (low and high frequency resonances). These methods have been used to produc nuclear alignment of Hg^{201} in the 6 $^1S_0$ ground state. Nuclear alig ment was observed in pure Hg vapour (enriched sample containin 90% of Hg^{201}). The vapour was illuminated with non-polarized in the direction of the static magnetic field. The light source illed with Hg^{198} (so that only the 3/2 component of Hg^{201} was ed) or with Hg^{204} (exciting the 5/2 component only). At 10 kc/s ar magnetic resonance was observed at about 35.6 G. The of the observed lines (about 10 cycles) showed that collisions walls did not destroy orientation of mercury nuclei contrary servations with alkali metals.

539.18

7661 A GENERAL FORMULA FOR THE CALCULATION OF ATOMIC PHOTO-IONIZATION CROSS-SECTIONS.

rgess and M.J.Seaton.

hly Not. Roy. Astron. Soc., Vol. 120, No. 2, 121-51 (1960).

The general formula is derived by considering the model of a e electron moving in a central field. Approximate bound-state l functions, accurate for large radial distances, may be ob- d once the effective quantum numbers $\nu(=n^*)$ are known. Bates Damgaard have shown that such functions may be used to obtain estimates for bound—bound transition integrals. For bound— transitions use is made of approximate free-state radial tions having exact asymptotic forms, their phases being given $= \pi\mu$ where μ is the extrapolated quantum defect ($\mu = n - \nu$). results of extensive numerical calculations are summarized in es which permit the rapid calculation of transition integrals once energy levels are known. Both bound—free and bound—bound sition integrals may be obtained. For bound—bound transitions ν' good agreement is obtained with the Bates and Damgaard es for $|\nu - \nu'| \geq 1.5$. Comparisons are made with other results bound—free transitions, as obtained both from theory and from eriment. In nearly all cases the general formula gives results east as accurate as those obtained in the best alternative methods alculation.

539.18

17662 ELECTRON IMPACT EXCITATION OF POSITIVE IONS: APPLICATION TO Ca^+ 4s—4p AND 3d—4p.

van Regemorter.

nthly Not. Roy. Astron. Soc., Vol. 121, No. 2, 213-31 (1960).

A review is given of different approximate methods for nputing cross-sections for transitions in positive ions produced electron impact. It is shown that it is necessary to take into count the distortion by the ion field, and, for strong optically owed transitions, one must allow for strong coupling effects. plication to the 4s—4p and 4p—3d transitions in singly ionized cium shows that the neglect of strong coupling effects over- imates the cross-sections. However, results computed with a ulomb distorted wave approximation, with allowance for strong upling effects, are much bigger than those of Jefferies, who had nsidered only one value ($l = 1$) of the angular momentum of the ident electron, whereas the main contribution is shown to occur $l = 4$. The Bethe approximation, with allowance for Coulomb stortion, implies in fact two different approximations: the weak upling approximation and the "long range approximation". It is ssible to make corrections for strong coupling effects and, for rong allowed transitions such as 4s—4p and 4p—3d in Ca^+, this ethod gives good results in a very simple way.

539.18

17663 MAGNETIC RESONANCE OF ATOMIC LEVELS OF CADMIUM EXCITED BY ELECTRON BOMBARDMENT.

.Barrat and J.C.Pebay-Peyroula.

.R. Acad. Sci. (Paris), Vol. 251, No. 1, 56 (July 4, 1960).

French.

Several magnetic dipole transitions between atomic levels of dmium and cadmium ions were observed and identified.

P.M.Parker

539.18

17664 HYPERFINE STRUCTURE OF THE METASTABLE $^3P_2$ STATE OF Cd^{111} and Cd^{113}.

.Faust, M.McDermott and W.Lichten.

hys. Rev., Vol. 120, No. 2, 469 (Oct. 15, 1960).

The hyperfine intervals of Cd^{111} and Cd^{113} (5s, 5p, $^3P_2$) are $\nu^{111}(F = \frac{5}{2}, F = \frac{3}{2}) = 8232.341 \pm 0.002)$ Mc/s; $\Delta\nu^{113}(F = \frac{5}{2}, F = \frac{3}{2}) =$ 611.586 ± 0.004) Mc/s. The measured hyperfine anomaly is .0016 ± 0.0003)%.

539.18 : 539.16

K-ELECTRON EXCITATION ACCOMPANYING K CAPTURE Cs^{131}. See Abstr. 17539

539.18

17665 ON EXCITED BOUND STATES OF NEGATIVE ATOMIC IONS. E.Holøien.

J. chem. Phys., Vol. 33, No. 1, 310-11 (July, 1960).

Semiempirical calculations of the detachment potentials for some singly excited states have been carried out in the case of H^-, He^- and Li^-. Before extrapolation, experimental results have been checked for smoothness and corrected where necessary. The results predict the 2^3S state in H^- to be unbound in agreement with theoretical results together with a bound P state. Excited bound states are also predicted in the case of He^- and Li^-.

R.A.Ballinger

539.18

17666 REMARKS ON DOUBLY EXCITED STATES OF THE NEGATIVE ATOMIC HYDROGEN ION. E.Holøien.

J. chem. Phys., Vol. 33, No. 1, 301 (July, 1960).

It is shown that the doubly excited states of H^- are all subject to autoionization, except the series $(2pnq)^{1,3}L$, where q=L=1,2... and $n \geq L + 1$, which decay by dipole transitions with lifetimes of the order 10^{-7} sec. See Abstr. 715 of 1959.

J.Hawgood

539.18

17667 THE SOLUTION OF CAPTURE—CASCADE EQUATIONS FOR HYDROGEN. M.J.Seaton.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 2, 90-7 (1959).

Calculations are made for $T = 2.5 \times 10^3$, 5×10^3, 1×10^4 and 2×10^4 °K taking an infinite number of levels into account but assuming that $b_{nl} = [(2l + 1)/n^2]b_n$. The results obtained by Baker and Menzel (Abstr. 3137 of 1938) are shown to be in error by about 5% for Case A and 20% for Case B. An improved method of calculation results from the introduction of the cascade matrix, the elements $C_{n'n}$ giving the total probability of the $n' \rightarrow n$ transition when all cascade routes are taken into account.

539.18

17668 THE PHOTO-DETACHMENT OF H^-. T.L.John.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 41-7 (1960).

The photo-detachment cross-section of H^- is calculated numerically using exchange free waves. The improvement obtained by using exchange wave functions is shown by making a comparison with experimental results.

539.18 : 539.14

17669 ATOMIC g_J VALUES FOR NEON AND ARGON IN THEIR METASTABLE $^3P_2$ STATES; EVIDENCE FOR ZERO SPIN OF $_{10}Ne^{20}$. A.Lurio, G.Weinreich, C.W.Drake, V.W.Hughes and J.A.White.

Phys. Rev., Vol. 120, No. 1, 153-7 (Oct. 1, 1960).

The gyromagnetic ratios of neon and argon in their metastable $^3P_2$ states were measured by the atomic beam magnetic resonance method. The results are $g_J(Ne, ^3P_2) = 1.500888 \pm 0.000005$ and $g_J(A, ^3P_2) = 1.500964 \pm 0.000008$, in agreement with the less precise optical spectroscopic measurements. Theoretical values, including radiative and relativistic effects, are $g_J(Ne, ^3P_2) = 1.50088$ and $g_J(A, ^3P_2) = 1.50095$, in good agreement with the experimental values. In addition, the Zeeman transition frequency for neon was measured as a function of magnetic field to obtain evidence that the magnetic moment of Ne^{20} is less than 4×10^{-4} nuclear magnetron and hence that the spin of Ne^{20} is probably zero.

539.18

17670 TRANSITION PROBABILITIES FOR FORBIDDEN LINES OF Ne IV. R.H.Garstang.

Monthly Not. Roy. Astron. Soc., Vol. 120, No. 3, 201-3 (1960).

Transition probabilities have been computed for magnetic dipole and electric quadrupole radiation for transitions between the levels of the $2p^3$ configuration of Ne IV. The results of a calculation of the relative intensities of lines of the $^2P—^2D$ multiplet are compared with observation.

539.18

17671 CAPTURE OF K^- MESONS FROM HIGH S ORBITALS IN HELIUM. T.B.Day and G.A.Snow.

Phys. Rev. Letters, Vol. 5, No. 3, 112-14 (Aug. 1, 1960).

Processes are considered in which the $(K^- \alpha)^+$ atom formed can participate. It is assumed that the atom is under the influence of the molecular field of a neighbouring helium atom. Estimates are made of the rates for capture by the molecular Stark effect and by the external Auger process. For the expected high principal quantum number ($n \sim 20\text{-}30$) S state capture via the molecular Stark effect should predominate by a factor of ~ 10-50. If, however, n values ~ 10 were reached, P wave capture via the Stark effect would predominate. A.Ashmore

539.18 : 539.11

17672 VACUUM POLARIZATION EFFECTS ON ENERGY LEVELS IN μ-MESONIC ATOMS.

R.Glauber, W.Rarita and P.Schwed.
Phys. Rev., Vol. 120, No. 2, 609-13 (Oct. 15, 1960).

The shifts of the energy levels of μ-mesonic atoms due to vacuum polarization are calculated for the states $n = l + 1$. The first-order perturbation integrals are evaluated both in closed form and by means of series expansions. A more accurate calculation of the energy shifts which takes into account the alteration of the atomic wave-functions by the vacuum polarization potential is also described.

539.18 : 539.14

NUCLEAR POLARIZATION IN A MESIC DEUTERIUM ATOM.

See Abstr. 17485

539.18 : 539.14

17673 ATOMIC MASSES IN THE HEAVY MASS REGION.

V.B.Bhanot, W.H.Johnson, Jr and A.O.Nier.
Phys. Rev., Vol. 120, No. 1, 235-51 (Oct. 1, 1960).

A 6 in. double-focusing mass spectrometer was employed to determine 61 mass doublets in the region of gadolinium to gold. The present results and other Minnesota mass data have been combined with nuclear reaction, β-decay, and α-decay energies in order to construct a mass table for more than 200 stable and radioactive isotopes in the region from samarium to radon. Total atomic binding energies as well as nucleon separation and pairing energies have been computed, wherever possible. The present data confirm with greater detail the previously reported anomalies in the nucleon separation and pairing energies in the regions around 90 neutrons and 116 neutrons. The proton pairing energies are found to show rather pronounced "maxima" around $N = 88$ and $N = 116$, a behaviour similar to the previously reported behaviour of neutron pairing energies. The nature of the discontinuities in these two regions does not appear to follow the patterns found at major shell closures but seems to be caused by a change in the nuclear structure in these regions. It is known that such a change is indicated also by other nuclear properties. Major discontinuities connected with the shell closures at $Z = 82$ and $N = 126$ are brought out in greater detail than has previously been possible. The mass data were also employed for the study of isotopic assignments for several nuclear reactions in this region.

539.18

17674 PRECISION MEASUREMENT OF THE RELATIVE ABUNDANCE OF ISOTOPES WITH A MASS SPECTROMETER.

K.Habfast.
Z. InstrumKde, Vol. 68, No. 4, 82-6 (April, 1960). In German.

This paper describes a new electronic circuit making possible the measurement of the relative abundance of isotopes with an absolute sensitivity of better than $1 : 10^6$. Using a new dual collector system, the method is suitable for precise determinations of absolute isotope ratios.

539.18

17675 EQUILIBRIUM CONSTANTS FOR BORON ISOTOPE EXCHANGE REACTIONS.

S.V.Ribnikar.
Bull. Inst. Nuclear Sci. "Boris Kidrich", Vol. 8, 31-41 (March, 1960).

The rate and magnitude of the boron isotope exchange reactions between boron trifluoride gas and its liquid compounds with ethyl ether, n-butyl ether, ethyl formate and water were investigated. The direction of the enrichment of B^{10} is found to be in the liquid phases, with equilibrium constants being between 1.025 and 1.031 at 20°C.

539.18 : 541.12

17676 SEPARATION OF BORON ISOTOPES. IV. THE METHYL SULFIDE—BF_3 SYSTEM.

A.A.Palko and J.S.Drury.
J. chem. Phys., Vol. 33, No. 3, 779-81 (Sept., 1960).

For Pt III, see Abstr. 7400. The exchange of boron between BF_3 (gas) and the dimethyl sulphide—BF_3 complex (liq.) was studied from $-20°$ to $+26°C$. The single-stage separation factor changed from 1.056 to 1.031 over this temperature range with B^{10} concentrating in the liquid phase. Vapour pressures of dimethyl sulphide and of various mixtures of BF_3 and dimethyl sulphide were determined. ΔH for the reaction

$$BF_3\ (gas) + Me_2S\ (liq.) \rightarrow BF_3\ \ Me_2S\ (liq.)$$

was estimated to be -10.1 kcal/mole over the above temperature range. The melting point of the 1 : 1 complex was $-19.6°$ C.

539

17677 NOTE ON THE PREPARATION OF ANHYDROUS RARE-EARTH CHLORIDES FOR THE ELECTROMAGNETIC ISOTOPE SEPARATOR.

B.S.Jensen.
Nuclear Instrum., Vol. 1, No. 6, 323 (Dec., 1957).

A quick and simple procedure for preparing anhydrous rare-earth chlorides in amounts ranging from 50 to 300 mg is desirabl for use in charging the isotope separator. The method chosen is adaptation of the well-known ammonium chloride method. The procedure to be described has been used successfully in the preparation of the anhydrous chlorides of Gd, Dy, Er, Yb, and Lu. Th yield of the transformation of the oxides into chlorides is estimat to be 70-90% depending on circumstances.

539.

17678 AN EXTRACTION OF Hg^{198} FORMED IN GOLD BY SLOW NEUTRON IRRADIATION IN THE SACLAY P2 PILE.

J.Beydon, G.Delmas, J.Druaux and P.Griboval.
J. Phys. Radium, Vol. 19, Suppl. No. 12, 134A-146A (Dec., 1958). In French.

The extraction by distillation under high vacuum of Hg^{198} obtained from irradiation of Au with slow neutrons was studied. Measurements of efficiency of extraction and of neutron flux have been made by dosing Hg^{198} contained in gold, by the isotopic dilut method. This consists in carrying out a chemical separation of Hg^{198} contained in Au after the addition of a known quantity of natural mercury used as a carrier, then making an isotopic analys of the mercury obtained. The results confirm the possibility of extracting the mercury from Au completely even when the initial content is as low as 2×10^{-4}. The percentage calculation of Hg^{199} in Hg^{198} is 3 parts per thousand approximately under the condition of irradiation. It is possible to obtain several tens of mg of this mercury after some months of irradiation in a flux of 2×10^{11} n cm^2 s^{-1}.

539.

17679 ISOTOPIC ANALYSIS OF SILICON BY SOLID-SOURC MASS SPECTROMETRY USING NEGATIVE IONS.

D.C.Newton, J. Sanders and A.C.Tyrrell.
Nature (London), Vol. 187, 683 (Aug. 20, 1960).

Thermal ionization of solids was used to measure the abunda of silicon isotopes. It was not possible to detect a positive ion fro thermal ionization, but after reversing the polarity of the accelerating voltage and magnetic field of the instrument used, negative ions were measured corresponding to $(SiO_3)^-$ at values of m/e of 76, 77 and 78. Best results were obtained from caesium silicate. There were only small peaks from potassium silicate, and no ions were obtained from sodium silicate. R.Schnurman

539.1

17680 A CONTRIBUTION TO THE STUDY OF THE CHANGE ISOTOPE CONTENTS AFTER SOME TRANSFORMATI PROCESSES IN NORMAL WATER.

L.Knop and J.Kristan.
"J. Stefan" Inst. Rep., Vol. 3, 141-8 (Oct., 1956). In German.

Results are tabulated of the isotope contents of water samples from many sources, both natural and industrial. The method of analysis is described, and a modified procedure given for equalizing, by means of SO_2, the $(O^{17} + O^{18})$ contents between test and standard water samples. W.Go

539.

17681 ISOTOPE ENRICHMENT BY THE SLOW EVAPORATI OF WATER.

L.Knop and F.Stern.
"J. Stefan" Inst. Rep., Vol. 3, 149-56 (Oct., 1956). In German.

Water samples of various origins were evaporated to 2.5% of their original volume. Analysis at successive stages in the evaporation showed that the $(O^{17} + O^{18} + D)$ content of sea water increased more rapidly than in other samples, though all reached the same final enrichment level. "Standard" water with salt adde to simulate sea water does not show this behaviour. SO_2 was use to "normalize" the samples in relation to $(O^{17} + O^{18})$ content (see preceding abstract). d values (10^{-6} g cm^{-3}) are tabulated for $(O^{17} + O^{18})$ and (D). W.Go

539.18

682 OBSERVATION OF A DOUBLE RESONANCE IN AN ATOMIC BEAM. G.O.Brink and W.A.Nierenberg.
ys. Radium, Vol. 19, No. 11, 816-18 (Nov., 1958). In French.
agnetic Resonance Symposium (see Abstr. 4804 of 1959).

itions that are not otherwise observable in an atomic beam n apparatus have been observed by means of a double resonance ique. The method has been used to observe the $\Delta F = 0$ itions in K^{39}, and involves the use of three r.f. hairpins through the beam passes in succession. The frequency of the r.f. in rst and third hairpins is adjusted to produce the transition 1)⟷(1, −1). If an atom enters the transition region in the (2, −1), it will go to (1, −1) in the first hairpin and then back −2) in the third. Thus a small signal will be seen at the tor. If the transition (1, −1)⟷(1, 0) is excited in the second in, some of the atoms that have gone from (2, −1) to (1, −1) will (1, 0) and will not go back to (2, −1) in the third hairpin. An ase in detector reading will thus be seen when the transition 1)⟷(1, 0) is excited. All of the possible $\Delta F = 0$, $\Delta M = \pm 1$ itions have been observed in the case of K^{39} by choosing the r $\Delta F = \pm 1$ transition. Certain precautions are necessary, ver, to observe some of them. The transition (2, 0)⟷(1, −1) 2, −1)⟷(1, 0) are an unresolved doublet. If these transitions xcited in the first and third hairpin, the transitions ⟷(2, −1) or (1, −1)⟷(1, 0) cannot be observed when they are ed in the second hairpin. This is found to be generally true; that ever the $\Delta F = \pm 1$ transition involves both of the levels of the 0 transitions, the latter cannot be observed. In order to observe $\Delta F = 0$ transitions, the $\Delta F = \pm 1$ transition (2, 0)⟷(1, 0) must cited in the first and third hairpins. Certain of the $\Delta F = 0$ itions form doublets, the components of which are separated $_I\mu_0 H$. It is hoped to use this technique to measure nuclear etic moments of radioactive nuclei.

539.18

7683 A STUDY BY MAGNETIC RESONANCE IN ATOMIC BEAMS OF THE EXCITED STATES OF CADMIUM ZINC, AND OF CADMIUM II AND ZINC II IONS.
neux and B.Wanders-Vincenz.
. phys. Acta, Vol. 33, No. 3, 185-220 (1960). In French.

The magnetic dipole resonance method was applied to excited ls of Cd, Zn, Cd II and Zn II, in an atomic beam. The levels e excited either by an optical method or by electron impact. following quantities were determined. Atomic Cd: (a) 5^3P_1 — ratio of Lande g factors for even and odd isotopes, hyperfine cture constant of Cd^{111} and Cd^{113} and lifetime, polarization entage versus electron energy; (b) 6^1D_2 state — lifetime; (c) state — lifetime. Atomic Zn: (a) 4^3P_1 state — polarization entage versus electron energy; (b) 5^1D_2 state — lifetime $4d^9\,5s^2\,{}^2D_{5/2}$ state and ZnII $3d^9\,4s^2\,{}^2D_{3/2}$ state — lifetime polarization percentage. This seems to be the first time that netic dipole resonance of nonmetastable excited states of free has been observed. In addition, this work leads to some general iderations concerning the possibility of applying the magnetic le resonance method to atomic beams.

539.18 : 539.14

ATOMIC-BEAM MEASUREMENT OF THE HYPERFINE UCTURE AND NUCLEAR MOMENTS OF IODINE-131. See tr. 17484

539.18

7684 A METHOD OF MEASURING NUCLEAR MAGNETIC MOMENTS USING THREE OSCILLATING FIELDS NG AN ATOMIC BEAM. G.K.Woodgate and P.G.H.Sandars.
hys. Radium, Vol. 19, No. 11, 819-20 (Nov., 1958). In French.
Magnetic Resonance Symposium (see Abstr. 4804 of 1959).

ethod of observing the $\Delta m_J = 0$ transition in a short atomic m apparatus is described. An atomic beam passes through e radiofrequency loops. This apparatus gives a direct measure- t of nuclear magnetic moments. In practice K^{39} was studied.

539.18

17685 ATOMIC BEAM RESONANCE APPARATUS WITH SIX-POLE MAGNETS FOR RADIOACTIVE ISOTOPES.
indgren.
lear Instrum., Vol. 3, No. 1, 1-16 (July, 1958).

The construction of an atomic beam resonance apparatus with using six-pole magnets for measurements of spins and magnetic ments of radioactive nuclei is reported. The main features are similar to those of the apparatus of Hamilton, Lemonick, and Pipkin. The principles of the design and of maximizing the intensity are discussed. The effective solid angle, averaged over the velocity distribution of the beam, has been calculated to be about 3×10^{-4} steradians in a typical case, which is one order of magnitude larger than can be obtained by the conventional method. The apparatus has been used for measurements on four radioactive bismuth isotopes.

539.18 : 539.11

BOUNDS ON SCATTERING PHASE SHIFTS: STATIC CENTRAL POTENTIALS. See Abstr. 17252

539.18

17686 APPROXIMATE ANALYTIC APPROACH TO THE CLASSICAL SCATTERING PROBLEM.
G.W.Lehman and K.A.Shapiro.
Phys. Rev., Vol. 120, No. 1, 32-6 (Oct. 1, 1960).

An approximate analytic approach to the problem of determining differential scattering cross-sections for classical central-field repulsive forces is described. It is shown that the impact parameter, b, can be approximated by $b = R\cos(\theta/2)$, where R is approximately the distance of closest approach and θ is the scattering angle in the centre-of-mass system. A simple approximation gives the potential energy of interaction between two atoms as $V(R) = 2E\sin(\theta/2)$, where E is the energy in the centre-of-mass system. Simple analytic expressions for the differential scattering cross-section, σ, are derived from the above two relationships for three special cases of a two-parameter screened Coulomb potential energy,

$$V(R) = Z_1 Z_2 e^2 A \exp(-pAR)[1 - \exp(-AR)]^{-1},$$

where $Z_i e$ is the charge on the i-th atom, A^{-1} is a screening radius, and p is an adjustable parameter which is restricted to $\frac{1}{2}$, 1, and 2 in this paper. A new and improved method for calculating σ exactly is also discussed and is used to compute the exact behaviour of σ for $p = 1$. A table is presented which allows one to compare the exact and approximate σ's for $p = 1$ over a wide range of energy and scattering angles. The agreement is particularly good for large energy transfer.

539.18

17687 THE SCATTERING OF ELECTRONS BY FREE NEUTRAL ATOMS IN THE THOMAS—FERMI MODEL.
T.Tietz.
Acta. phys. Hungar., Vol. 9, No. 1-2, 163-8 (1958).

The intensity due to elastic and inelastic scattering is derived as an analytic expression, using an approximate analytic solution of the Thomas—Fermi equation. J.Hawgood

539.18

17688 ELASTIC SCATTERING OF ELECTRONS BY AN APPROXIMATE POTENTIAL OF THE SELF-CONSISTENT FIELD FOR IONS IN THE FIRST AND SECOND BORN APPROXIMATION. T.Tietz.
Acta. phys. Hungar., Vol. 11, No. 3, 259-64 (1960).

The cross-section is calculated in this approximation, using an analytic approximation to the Hartree function as the potential in a Dirac equation. J.Hawgood

539.18

17689 COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS. V. EXCITATION OF METASTABLE 2S HYDROGEN ATOMS.
R.F.Stebbings, W.L.Fite, D.G.Hummer and R.T.Brackmann.
Phys. Rev., Vol. 119, No. 6, 1939-45 (Sept. 15, 1960).

For Pt IV, see Abstr. 1475 of 1960. Ground-state hydrogen atoms produced by thermal dissociation in a tungsten furnace were excited by collision with electrons having energies up to 600 eV. Those atoms which were excited to the metastable 2S state were subsequently quenched in an electrostatic field, and the resulting Lyman-alpha radiation was detected with an iodine-vapour-filled photon counter. In order to assign absolute cross-section values to the excitation function obtained in this way, the ratio of the 2S to the 2P excitation cross-sections was determined. From previously obtained knowledge of the cross-section for excitation to the 2P state, the absolute 2S cross-section was evaluated. Agreement with the Born approximation was observed at high energies. The angular distribution of the scattered 2S atoms was also investigated for electron energies up to 600 eV.

539.18

17690 UPPER BOUND ON TOTAL ELECTRON SCATTERING CROSS SECTIONS IN HYDROGEN.

N.A.Krall and E.Gerjuoy.

Phys. Rev., Vol. 120, No. 1, 143-4 (Oct. 1, 1960).

Dispersion relations for electron—hydrogen scattering are combined with existing scattering length calculations. The sign of the scattering length is shown to give an upper bound on $\int \sigma(k)\,dk$ where $\sigma(k)$ is the total cross-section for scattering of electrons of incoming momentum $\hbar k$. Recent calculations of the scattering length are used to determine this limit. An experiment by Fite et al. satisfies this bound, agreeing with the recent calculations of the scattering length.

539.18

17691 COLLISION PROCESSES IN MIXTURES OF MERCURY VAPOR AND FOREIGN GASES.

D.E.Cunningham and L.O.Olsen.

Phys. Rev., Vol. 119, No. 2, 691-3 (July 15, 1960).

For abstract, see Abstr. 13400 from which the journal reference was accidentally omitted.

539.18 : 539.12

17692 ON THE POLARIZATION OF PHOTONS ELASTICALLY SCATTERED BY MERCURY ATOMS.

G.Böbel and G.Passatore.

Nuovo Cimento, Vol. 15, No. 6, 979-82 (March 16, 1960).

Describes calculations, using the T-matrix method (Abstr. 900 of 1950) on the polarization of photons of incident energies between 0.32 and 2.56 mc^2 after elastic scattering by mercury atoms. The effects of Rayleigh and Thomson scattering and their interference are taken into account. Detailed results are given for the linear polarization of the scattered beam at various angles for Rayleigh scattering of an unpolarized beam by K-electrons only, and for the circular polarization on scattering an incident beam polarized linearly at 45° to the scattering plane. The effect of coherent superposition of Rayleigh on Thomson scattering is investigated for a photon energy of 2.56 mc^2 and measurements are to be carried out at this energy. The results of other recent measurements relevant to the above calculations are discussed. R.E.Meads

539.18

17693 OPTICAL PUMPING.

R.L.de Zafra.

Amer. J. Phys., Vol. 28, No. 7, 646-54 (Oct., 1960).

A brief review is given of the basic concepts of optical pumping, followed by description of an optical pumping apparatus suitable for application to a number of experiments in an advanced undergraduate, or graduate laboratory.

539.18

17694 OPTICAL PUMPING OF ALKALINE ATOMS IN A FOREIGN GAS UNDER HIGH PRESSURE AND THE DETERMINATION OF SPIN DISTRIBUTION. A.Bloom.

J. Phys. Radium, Vol. 19, No. 11, 881-9 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Experiments have been performed on the optical pumping and magnetic resonance of alkali vapour in argon with pressures greater than 20 mm Hg. The resonances observed have been the Zeeman resonance in Na, K and Rb, and hyperfine resonances in Na and K. Relative signal intensities have been studied with a view to obtaining information on the exact nature of the pumping process and the distribution of spin population among the ground state sublevels. It is indicated that two principal factors have to be taken into account in order to describe the pumping. One is the preferential absorption of certain spectral components of the light, resulting in intensity differences which can produce optical pumping at the rear of the absorption cell. The simpler problems of this sort have exact mathematical solutions. The other factor is the behaviour of atoms in the optically excited states. Approximate signal intensity calculations have been made, based on two alternative assumptions: (a) that the spins are completely randomized among sublevels of the P states before reemitting light, and (b) following a suggestion of Dehmelt (see Abstr. 6470 of 1957), that only the electron spins are randomized, the nuclear spins remaining unperturbed. The experimental results appear to verify the importance of the preferential light absorption. The signal intensities agree generally with the hypothesis of complete randomization in the excited states, except for one example in sodium which is in clear disagreement with this interpretation. With sodium, it appears possible to start with unpolarized light and obtain, at the rear of the absorption cell, about 90% of the population in the F = 2 state (as against 62% whe not pumped). If the light is circularly polarized, then the popula is further compressed into only 3 magnetic sublevels.

53

17695 THE USE OF OPTICAL ORIENTATION FOR ATOMI CLOCKS AND FREQUENCY STANDARDS. T.R.Car

J. Phys. Radium, Vol. 19, No. 11, 872 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Abstract only given, substantially as follows. The detection of $\Delta m_F = 0$ transitions in the hyperfine structure of ground state alkali atoms suitable for atomic standards using optical orientati and buffer gas Doppler reduction requires variations in the usual methods of optical polarization. The optical orientation and mic wave detection methods employed to achieve a 70 cycle line widt in Rb^{87} are described. The use of intensity variations has also recently been applied to provide optical detection. Limitations i posed by the pressure shift caused by buffer gases and limitatio in line width brought about by pressure shift are discussed. It appears that the limits imposed by these effects have been reach A variety of methods especially suitable to increase the detectio sensitivity in $\Delta m_F = 0$ transitions are mentioned.

539.18 : 53

17696 STATISTICAL PROPERTIES OF ATOMIC AND NUCLEAR SPECTRA. C.E.Porter and N.Rosenzweig

Ann. Acad. Sci. Fennicae A VI, No. 44, 66 pp. (1960).

A brief survey is presented of the experimental data on the distributions of the neutron widths of nuclear fine-structure leve and of the nearest-neighbour spacings for both atomic and nuclea energy levels. Random-matrix models to predict these data are discussed both analytically where possible and via Monte-Carlo machine calculations. Evidence from explicit atomic and nuclear model calculations is shown to support the statistical hypotheses suggested for the Hamiltonian matrix. On this basis, it is found possible to achieve a unified discussion of the underlying statisti properties of atomic and nuclear spectra excluding collective phenomena of which the statistical behaviour of the fission widths is the most prominent example.

539

17697 THE GENERALIZED RACAH COEFFICIENT.

I.Brănduş and A.Săndulescu.

Stud. Cercetari Fiz., Vol. 10, No. 1, 111-16 (July, 1959). In Roumanian.

(See Abstr. 634, 2172 of 1943). Transformations between different coupling schemes of six moments of the quantity of motion were studied and a generalized Racah coefficient, M, defined for this case. The authors then discuss the properties of the coefficient M, their relationship with the other Racah coefficient W and U, the symmetry relations and the recurrence between the different values of M.

539

17698 THE HYPERFINE INTERACTION HAMILTONIAN.

S.M.Blinder.

J. molecular Spectrosc., Vol. 5, No. 1, 17-23 (July, 1960).

A simplified alternate derivation is given for the hyperfine energy expression first discovered by Fermi. The starting point the Dirac equation for an electron in the electromagnetic field of nucleus. An approximate reduction is carried out, corresponding neglect of terms second order and higher in v/c. Energy terms proportional to the nuclear moment are evaluated and the delta fu tion approximation for the contact term is justified. Radiative corrections are not considered.

53

17699 THE POLARIZATION OF ATOMIC LINE RADIATION EXCITED BY ELECTRON IMPACT.

I.C.Percival and M.J.Seaton.

Phil. Trans A, Vol. 251, 114-38 (Nov. 6, 1958).

The dipole radiation emitted by an atom excited by a unidire tional electron beam has a non-uniform angular distribution whic is simply related to the percentage polarization P of the radiatio emitted perpendicular to the beam. P was first calculated using Oppenheimer—Penney (O.-P.) theory. In this theory the probabil of excitation of an upper quantum state and the probability of sub sequent emission of a polarized photon from such a state are con sidered independently. P is finally expressed in terms of the cro sections $Q_{|M_L|}$ for excitation of states of definite component of ar momentum along the direction of the electron beam. In al, P is dependent on detailed numerical calculations of $Q|M_L|$, e selection rule $\Delta M_L = 0$ removes this dependence at threshold. O.-P. theory allowance may be made for fine structure and fine structure, but the theory is ambiguous when the f.s. or separations are comparable with the line width. A theory is fore developed which is based on the calculation of the probability olarized photon being emitted by the complete system of + electron. The ambiguity of the O.-P. theory is removed by ration over line profiles, but the expressions reduce to O.-P. essions when the f.s. or h.f.s. separations are much smaller or larger than the line width. The Lyα line of hydrogen is an mediate case for which the line widths and the h.f.s. separations omparable. Assuming the validity of the Born approximation, ple expression is obtained which allows the $Q|M_L|$ to be calcul- from the angular distribution of the scattered electrons. retical predictions are compared with experimental results.

539.18

7700 THE INTERPRETATION OF INDUCED INFRARED SPECTRA OF COMPRESSED GASES.

E.E.Nikitin.

ka i Spektrosk., Vol. 8, No. 2, 264-6 (Feb., 1960). In Russian.

A linear dependence of the splitting of the Q-band on the density n inert gas, reported by Chisholm and Welsh (Abstr. 5464 of 4), is explained qualitatively within the framework of the author's ry (Abstr. 9790 of 1960). A.Tybulewicz

539.18

17701 THE EFFECT OF BUFFER GASES ON THE SHIFT OF LINE WIDTHS AND FREQUENCIES IN HYPERFINE ANSITIONS OF THE GROUND STATE OF ALKALI ATOMS.

Arditi.

Phys. Radium, Vol. 19, No. 11, 873-80 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). In quency standards based on the field independent hyperfine trans- n in the ground state of alkali metal vapours in a gas cell, a fer gas is usually introduced both for Doppler width reduction and increasing useful population differences and detection sensiti- y when employing optical orientation and optical detection thods. Investigations of the pressure shift produced by various fer gases or mixtures of gases (hydrogen, helium, nitrogen, neon, on, xenon or krypton) in the microwave transitions (2,0), (1,0) in ^{23} or (4,0), (3,0) in Cs^{133} is reported. The variations in the line lth, as the pressure of the gas is varied,are discussed. The erimental results suggest pressure shifts for the hyperfine nsitions quite similar to optical pressure shift and line asym- try of alkali metal resonance radiations in rare gases, although order of magnitude of the effect is quite different.

539.18 : 537.56

17702 BROADENING AND SHIFT OF SPECTRUM LINES IN THE PLASMA OF A GAS DISCHARGE.

L.Mandel'shtam and M.A.Mazing.

. Akad. Nauk SSSR, Ser. fiz., Vol. 23, No. 8, 1017-20 (1959). Russian.

The broadening of lines with a quadratic Stark effect by charged rticles was investigated in the spark discharge channel (A atmo- here at normal pressure), the A II lines being investigated. The ating spectrograph DFS-3, with a dispersion of 2 A/mm, was ed. The accuracy of the width measurements was 5-10% at of the shift measurements 0.02-0.05 A. The results are at riance (qualitatively) with the theory of Weisskopf—Lindholm: en C_4 (the constant of the quadratic Stark effect) changes by e factor 10^2, the line width changes only by the factor 3 (instead 20); similarly, the shift depends on C_4 either more or less than $_4^{2/3}$. The discrepancy with theory made it necessary to carefully alyse the foundations of theory, and a nonstationary theory of oadening was developed. The experimental results are in good greement with the new theory. F.Lachman

539.18

17703 INTENSITY RATIOS OF SPECTRAL LINES IN CdI TRIPLETS AT DIFFERENT CONDITIONS OF XCITATION.

Z.Leś and H.Niewodniczański.

cta phys. Polon., Vol. 17, No. 5, 365-8 (1958).

Variations in the intensity ratios of the visible triplet 5086 A, 800 A, and 4678 A in the CdI spectrum have been observed with hanges in (1) pressure of inert gas, and (2) current in the discharge be. The results differ from theoretical predictions.

G.I.W.Llewelyn

539.18

17704 COLLISION BROADENING AND SHIFT IN THE λ 6573 LINE OF CALCIUM.

W.R.Hindmarsh.

Monthly Not. Roy. Astron. Soc., Vol. 121, No. 1, 48-51 (1960).

The collision broadening and shift of the line Ca 6573 A due to an external pressure of helium have been measured. The half-intensity damping width of the line was found to be $1.42 \pm 0.07 \times \times 10^{-20}$ cm^{-1} atom^{-1} per cm^3 of helium, and the shift $0.19 \pm 0.05 \times \times 10^{-20}$ cm^{-1} atom^{-1} per cm^3 of helium towards the violet. The ratio of broadening to shift is 7.5. This result is shown to be consistent with the hypothesis that short-range repulsive forces between calcium and helium atoms are predominantly responsible for the broadening and shift. No deduction about collision broadening and shift in stellar atmospheres can be made from these laboratory results, but it is suggested that a study of more highly excited lines may yield astrophysically relevant results.

539.18

17705 OPTICAL ORIENTATION OF ATOMS IN CAESIUM VAPOUR.

T.Skalinski.

J. Phys. Radium, Vol. 19, No. 11, 890-900 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A detailed study is made of low frequency ($\Delta F = 0$, $\Delta m_F = 1$) resonance lines in Cs^{133}. This intensity is greatly increased by adding xenon at pressures ranging between 0.16 and 0.23 mm. At low r.f. amplitudes the width of the $\Delta m = 2$ lines was of the order of 7.5 kc/s; similar widths have been observed in high frequency transitions ($\Delta F = 1$, $\Delta m = \pm 1,0$) at 9 205.3 and 9 179.8 Mc/s. The are essentially due to field inhomogeneities.

539.18

17706 HYPERFINE STRUCTURE OF Eu II.

K.Krebs and R.Winkler.

Z. Phys., Vol. 160, No. 3, 320-32 (1960). In German.

By means of a Fabry—Perot interferometer the hyperfine structure of 10 lines of the Eu II spectrum was analysed and from the results splitting factors and isotope shifts were calculated. When evaluating the magnetic moment μ of Eu^{151} it was found that the two ground states ($a^9S_4^0$ and $a^7S_3^0$) of Eu II yield two distinctly different values for μ. This discrepancy can be removed assuming that a different electronic splitting factor (a_{6S}) has to be attributed to the 6 s-electron in each of these two states.

539.18

17707 RADIATIVE RECOMBINATION OF HYDROGENIC IONS.

M.J.Seaton.

Monthly Not. Roy. Astron. Soc., Vol. 119, No. 2, 81-9 (1959).

Using the first three terms in the asymptotic expansion of the Kramers—Gaunt factor, calculations are made for the rate of recombination and for the mean kinetic energy of the recombining electrons.

539.18

17708 FINE STRUCTURE OF SHORT-LIVED STATES OF HYDROGEN BY A MICROWAVE-OPTICAL METHOD. I.

W.E.Lamb, Jr and T.M.Sanders, Jr.

Phys. Rev., Vol. 119, No. 6, 1901-14 (Sept. 15 1960).

For previous work, see Abstr. 6852 of 1956. A radio-frequency determination of the fine structure of excited states of hydrogen atoms is described. In this method the atoms are excited by electron bombardment so that they emit radiation. Transitions among the fine structure levels are induced by a radio-frequency electric field and are detected by the consequent change in intensity of the emitted radiation. A detailed theory of the method is presented and the experimental apparatus is discussed and described. Some preliminary results for the n = 3 level of deuterium are: $\Delta E - \mathcal{S} = 2934.5 \pm 10$ Mc/s, $\mathcal{S} = 316.3 \pm 10$ Mc/s, where ΔE is the separation $3^2P_{1/2} - 3^2P_{3/2}$, and $\mathcal{S}$ the separation $3^2S_{1/2} - 3^2P_{1/2}$; these results are in agreement with predictions of quantum electrodynamics.

539.18

17709 FINE STRUCTURE OF SHORT-LIVED STATES OF HYDROGEN BY A MICROWAVE-OPTICAL METHOD. II.

L.R.Wilcox and W.E.Lamb, Jr.

Phys. Rev., Vol. 119, No. 6, 1915-33 (Sept. 15, 1960).

Improvements are described in the apparatus used in Pt I to determine fine structure separations in excited states n = 3 and 4 of deuterium. Experimental and theoretical studies are made of the effects of environmental electric field on the relative intensities of various resonances in order to obtain information about possible Stark shifts of the fine structure levels. The density matrix method, used in Pt I for two levels, is extended to N levels and is worked out more explicitly for the case of three levels. The splitting $3^2S_{1/2} - 3^2P_{1/2}$ is found to be 315.30 ± 0.80 Mc/s compared with a calculated value of 315.34 Mc/s. Less precise measurements are made for other separations which are also in good agreement with theory.

539.18

17710 HYPERFINE STRUCTURES OF SOME Hg I LINES.

D.H.Rank, G.Skorinko, D.P.Eastman, G.D.Saksena, T.K.McCubbin, Jr and T.A.Wiggins.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1045-52 (Nov., 1960).

Measurements of the hyperfine structures of Hg lines λ5461, λ4358, and λ4047 have been made. These lines were obtained in absorption. Photographs of λ5461 were made with a 10-m double-passed grating spectrograph in the 11th order of 300 line per mm gratings, one 7.25 in. wide and a second grating of 9.4 in. width. With the wider grating it was possible to resolve the central components of λ5461 and λ4358. Interferometric measurements of the structures of the three lines just mentioned were made using a modified D.U.D.E. procedure, particular attention being paid to accurately determine the over-all splittings of the $^3S_1$ state for Hg^{199} and Hg^{201}. In a similar fashion interferometric measurements of the hyperfine pattern of λ15 295 have been made. For λ5461 the interferometer has a resolving power of 2×10^6. A resolving power of 5×10^5 was used for λ15 295. For λ4358 the wider grating alone demonstrated a resolving power in excess of 10^6. The ratio μ^{201}/μ^{199} as was found from measurement of the over-all splitting of the $^3S_1$ state was 1.1090 ± 0.0007.

539.18

17711 HYPERFINE STRUCTURE OF Hg^{197}. AN APPLICATION OF THE LEVEL-CROSSING TECHNIQUE.

H.R.Hirsch and C.V.Stager.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1052-3 (Nov., 1960).

Measurements in the $6\ ^3P_1$ state of Hg^{197} yield a hyperfine structure splitting of 23 083.4 ± 6.7 Mc/s. Such accuracy is possible in a strictly optical experiment because the change in intensity of scattered light observed at a Zeeman-level crossing is unaffected by Doppler broadening.

539.18

17712 PRESSURE SHIFTS IN THE HYPERFINE STRUCTURE CONSTANT OF POTASSIUM. A.L.Bloom and J.B.Carr.

Phys. Rev., Vol. 119, No. 6, 1946-7 (Sept. 15, 1960).

Optical pumping and detection methods were used to determine the resonant frequency of the K^{39} m = 0 → m = 0 hyperfine line in various environments. Frequency shifts were observed in inert gases and in hydrogen; no shift was observed from a paraffin wall coating. The shifts, expressed as fractional changes in the hyperfine frequency, are similar to those in rubidium though generally somewhat smaller. The hyperfine constant itself was determined for both K^{39} and K^{41}.

539.18

17713 INFLUENCE OF INTERATOMIC RESONANCE ON THE FREQUENCY OF RE-EMITTED RESONANCE RADIATION. G.S.Kastha.

Indian J. Phys., Vol. 33, No. 12, 534-9 (Dec., 1959).

The presence of radiations of changed frequencies in the spectra of the resonance radiation of sodium and mercury filtered by the vapour of the corresponding element, has been explained on the hypothesis of resonance interactions between two excited atoms of the element. It has been pointed out that, according to this hypothesis, the maximum separation between the components of the transmitted doublet in the case of D_2 line of sodium would be twice that in the case of the D_1 line. This agrees fairly with the relative values of the maximum separation between the components of the doublets in these cases.

539.18

17714 HYPERFINE STRUCTURE, ZEEMAN EFFECTS, AND SEPARATION OF LINES IN TERBIUM SPECTRA.

S.P.Davis.

Astrophys. J., Vol. 132, No. 2, 486-92 (Sept., 1960).

Hyperfine structure splittings were measured for 232 lines in terbium spectra, Zeeman effects measured for approximately 600 lines, and relative intensities in arc and spark spectra estimated for approximately 3500 lines. The splittings form a practically con uous range of values within the limits of uncertainties of measu ment. The ground states of Tb I and Tb II were not found; nearly 90% of the Zeeman patterns are unresolved.

539.18 : 5

17715 THE FINE STRUCTURE OF THE L-MM AUGER ELECTRON SPECTRUM OF ARGON AND OF THE K-LL SPECTRA OF NITROGEN, OXYGEN AND METHANE.

W.Mehlhorn.

Z. Phys., Vol. 160, No. 3, 247-67 (1960). In German.

Investigated with an electrostatic spectrometer. The ioniza was caused by the continuous X-radiation from a tungsten target. From the results of Auger electron energies measure the binding energies of the electrons of the inner shells were calculated. The results obtained with argon agreed exactl with the known values. Further, it can be shown that the presen accepted value of 400 eV for the binding energy of a 1s-electron the N_2 molecule must be replaced by the value (409.4 ± 1.0) eV. comparison between the relative intensities of fine structure lin and the theory of the Auger process given by Asaad and Burhop (Abstr. 1995 of 1958) could not be carried out, because the Auge electrons (having in the present experiment an angular distribut relative to the incident X-ray beam) could only be measured in t angular range 49.3° to 61.0°.

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17716 CRITICAL POTENTIALS OF SOFT X-RAYS EMITT FROM IRON. T.Hayasi and H.Kawaharada.

Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 1, 1-5 (June, 19

Thomas has measured the critical potentials of soft X-rays emitted from iron. The critical potentials are compared with t exciting voltages calculated using Hayasi's theory. The absorpt maxima in the fine structure of the soft X-ray absorption spect in the case of a solid, are caused by the excitation of the electr from atom cores to quasi-stationary states in the meaning of Hayasi's theory. For iron, the fine structures of the K and M_{II} absorption spectrum have already been measured. From these measurements the energies of quasi-stationary states for iron be determined, and the exciting voltages of the core electrons o s or p symmetry to quasi-stationary states of p or s, d symmet can also be estimated respectively. The critical potentials mea and the exciting voltages calculated are compared and fairly go agreement is found.

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17717 CRYSTAL DIFFRACTION AND PHOTO ELECTRON MEASUREMENTS OF K AND L LEVELS IN THE ELEMENTS 47 Ag TO 52 Te.

P.Bergvall, O.Hörnfeldt and C.Nordling.

Ark. Fys., Vol. 17, Paper 6, 113-23 (1960).

Precision measurements by crystal diffraction of the $K\alpha_1$, α_2 X-ray emission lines in the elements Ag^{47} to Te^{52}, with an accuracy of ± 0.004 XU or ± 0.3 eV, are reported. The L_I and L_{II} levels in the same elements are determined with the photo electron method with an accuracy of ± 0.4 eV. Together with previous photo electron data on the L_{III} levels, and by addition of the K emission line energies to obtain the K levels, all of the four deepest atomic K and L level energies are given within ±0.5 eV.

5

17718 ON THE RELATIVISTIC K-SHELL PHOTOEFFECT M.Gavrila.

Nuovo Cimento, Vol. 15, No. 4, 691-4 (Feb. 16, 1960).

Comparison of the author's work (Abstr. 5056 of 1959) with that of others on the same topic, in particular Abstr. 3733 of 19 with comments on discrepancies. It is found that, to first order (αZ), no photoelectrons are emitted at $\theta = 0$ or π, contrary to previous results.

J.Haw

MOLECULES

539.19

19 THE CALCULATION OF DIAMAGNETIC SUSCEPTIBILITIES OF MOLECULES.

rty

Acad. Sci. (Paris), Vol. 249, No. 25, 2740-2 (Dec. 21, 1959).
nch.

ommencing with the first ionization energy of the free atom amagnetic suscpetibilities of molecules are calculated by shielding and bond energies into account. These theoretical are in excellent agreement with the experimental values for examples quoted; these include H_2,X_2,HX (X = halogen), H_2O, ydrocarbons, and alkyl halides. W.J.Orville-Thomas

539.19 : 537.56

720 THRESHOLD LAW FOR THE PROBABILITY OF EXCITATION OF MOLECULES BY PHOTON IMPACT. UDY OF THE PHOTOIONIZATION EFFICIENCIES OF Br_2, I_2, ND CH_3I.

orrison, H.Hurzeler, M.G.Inghram and H.E.Stanton.
em. Phys., Vol. 33, No. 3, 821-4 (Sept., 1960).

study was made of two types of excitation process in mole-, leading to either dissociation to an ion-pair, or to auto-ation. The latter process, in the case of the iodine-containing cules, clearly makes a very significant contribution to the total ation. The threshold law for the probability of excitation by n impact is shown to be approximated closely by a delta func-f the excess energy. Energy values were measured for us states of the molecules, and are in good agreement with able spectroscopic data. The electron affinities of Br and I found to be 3.53 ± 0.12 and 3.13 ± 0.12 eV, respectively.

539.19

721 PHOTODISSOCIATION IN THE SCHUMANN–RUNGE SYSTEM OF OXYGEN. D.W.O.Heddle.

em. Phys., Vol. 32, No. 6, 1889-90 (June, 1960).

A discussion of previous results, (Ditchburn and Heddle, Abstr. f 1955) in the light of the predissociation observed by nson and Mulliken (Abstr. 5443 of 1958) suggests that the issociation occurs as low as the (3,0) band. The line breadth o predissociation is then estimated to be 0.15 cm^{-1}, with an r limit of 0.25 cm^{-1}. This corresponds to a lifetime against issociation of 2×10^{-11} sec. The radiative lifetime is 10^{-9} sec so that the probability of predissociation is about The oscillator strength is probably somewhat greater than 0.20.
R.F.Barrow

539.19

722 SPIN EXCHANGE IN BIRADICALS.
D.C.Reitz and S.I.Weissman.

em. Phys., Vol. 33, No. 3, 700-4 (Sept., 1960).

The electron spin resonance spectra of four isotopically lled biradicals were observed. The hyperfine splittings demon-te independence of the halves.

539.19

7723 THE EVALUATION OF UREY-BRADLEY FORCE CONSTANTS IN PLANAR XY_3 TYPE MOLECULES.

Janz and Y.Mikawa.
olecular Spectrosc., Vol. 5, No. 2, 92-100 (Aug., 1960).

The force constants for the planar XY_3 species, BCl_3, SO_3, $^-$, CO_3^{2-}, and NO_3^- have been calculated on the basis of the y–Bradley type potential force field. The existence of a relation een the repulsion force constant and the separation distance nonbonded atoms is shown for the case of chlorine compounds oxygen compounds using the results for the above together with rvey of published data calculated by this force field for other ies. The species B_2Cl_4 and NO_3^- deviate noticeably from the irical correlation thus found. The structure of the nitrate ion onsidered in relation to the position of NO_3^- in this correlation.

539.19

7724 FORCE CONSTANTS FOR NH_4^+ AND ND_4^+.
S.Sundaram.

em. Phys., Vol. 33, No. 3, 708-9 (Sept., 1960).

Normal coordinate analysis, for XY_4-type molecules of T_d metry, was carried out by the Wilson FG-matrix method. Following Dennison, using the spectral data on NH_4^+ and ND_4^+, the anharmonicity factors were calculated. The constants of the most general quadratic potential-energy function were obtained for the ammonium ion.

539.19

17725 THE INTERMOLECULAR FORCE CONSTANTS OF RADON. G.A.Miller.

J. phys. Chem., Vol. 64, No. 1, 163-5 (Jan., 1960).

The Lennard-Jones parameters of radon are calculated empirically by examining the trend over the series of rare gases of the following properties: polarizability, ionization potential, melting, boiling and critical points, and the outer-shell Bohr radius. The values found are $\sigma = 4.35$ A and $\epsilon/k = 290°K$, leading to a dispersion energy of 10.8×10^{-58} erg cm^6. J.Hawgood

539.19

17726 ON THE VALIDITY OF THE CENTRAL FORCE FIELD IN MOLECULAR VIBRATIONS. A.Van de Vorst.

J. molecular Spectroscopy, Vol. 5, No. 1, 35-7 (July, 1960).

The force constants calculated using the central force field approximation for molecules of the type XY_2 and XYZ, and XY_3 are examined. It is found that the signs of the cross terms in the potential energy expressions are often in disagreement with experiment. Even where they agree in sign there are frequently errors of the order of a few hundred percent. T.E.Peacock

539.19

17727 CALCULATION OF THE VIBRATION FREQUENCIES OF DIATOMIC MOLECULES USING THE REDUCED MASS.

K.S.Krasnov and A.I.Maksimov.
Optika i Spektrosk., Vol. 8, No. 3, 403-6 (March, 1960). In Russian.

Analysis of the data for over 100 molecules led to the following equation for the vibrational frequency of a diatomic molecule: $\omega_e = (A/\mu) + B$ where μ is the reduced molecular mass, and A and B are constants. This equation can be used for diatomic molecules of the type XY, where X belongs to one group of the periodic table and Y to another group. Among such molecules are alkali halides (except lithium halides), alkali hydrides (except LiH), halides of the elements of Group V etc. A.Tybulewicz

539.19

17728 NOTE ON THE INTERNAL ROTATION PROBLEM.
W.L.Clinton.

J. chem. Phys., Vol. 33, No. 2, 632-3 (Aug., 1960).

The virial theorem requires the height of the barrier to internal rotation in a molecule such as ethane to be simply related to the difference in the electrostatic potential energies at the staggered and eclipsed configurations. For ethane, methyl amine, methanol and dimethyl acetylene the barriers observed are essentially those predicted from changes in proton–proton potential energy, the electron–electron and electron–nuclear contributions cancelling. Tentative extensions of such an electrostatic model to substituted ethanes are discussed, but are regarded as defective in taking no account of electronic energy changes. J.Sheridan

539.19

17729 VIBRATIONAL MEAN-SQUARE AMPLITUDE MATRICES. VII. TREATMENT OF TETRAHEDRAL XY_4 MOLECULES. S.J.Cyvin.

J. molecular Spectrosc., Vol. 5, No. 1, 38-43 (July, 1960).

For previous work, see Abstr. 8707 of 1959. The theory of mean-square amplitude matrices, is applied to the tetrahedral XY_4 molecular model. The elements of the symmetrized mean-square amplitude matrix, as well as a set of harmonic force constants, are related to the normal frequencies. The expressions are given for twelve mean-square amplitude quantities (nine of them being interaction terms) as linear combinations of the symmetrized mean-square amplitude matrix elements.

539.19

17730 MEAN AMPLITUDES OF VIBRATION IN MOLECULAR STRUCTURE STUDIES. S.J.Cyvin.

Acta polytech. Scand. Ph. 6(No. 279/1960) 226 pp.

A complete and valuable review of the study of mean amplitudes of vibration. The seven chapters include a survey of the principles of determining mean amplitudes from electron diffraction and from spectroscopic data. This is followed by a demonstration of the power of matrix techniques to solve secular equations; expressions are given for the mean-square amplitudes of XY_2, X_3,

X_4 and XY_3 systems. It is shown how force constants can be calculated from known mean-square amplitudes by a reversal of the usual procedure. The XY_4 molecule is dealt with as an illustration. A collection of numerical results is given. 137 references.
W.J.Orville-Thomas

539.19

17731 CALCULATION OF THE FUNDAMENTAL VIBRATIONS OF THE MOLECULES CO_2 AND CS_2 TAKING INTO ACCOUNT ANHARMONICITY. I.Gamo.
J. Phys. Radium, Vol. 20, No. 10, 839-40 (Oct., 1959). In French.

Reports calculations of the force constants, using the most general potential. For CO_2 and CS_2 the bond stretching force constants are found to be 15.980×10^5 and 7.8279×10^5 dynes/cm, the interaction constants 2.441 and 0.6615 and the bending constants 0.5807 and 0.2352 respectively. J.Hawgood

539.19

17732 EXPERIMENTALLY MEASURED VIBRATIONAL LEVELS IN H_2^+. P.Marmet and L.Kerwin.
Canad. J. Phys., Vol. 38, No. 7, 972-4 (July, 1960).

Appearance potential measurements of H_2^+ formed from H_2 by electron bombardment, using an electrostatic electron selector (Marmet and Kerwin, Abstr. 10949 of 1960) have been made. Average values of the the differences in electron energy required to produce successive breaks, together with probable values of the vibrational quantum numbers, v, and the relative probabilities, p, are:

ΔE, eV	v	p
0.27 ± 0.02	0-1	0.4
0.25 ± 0.02	1-2	0.6
0.23 ± 0.02	2-3	1.0
0.21 ± 0.02	3-4	0.7

The most probable transition appears to lie 0.75 eV above the theoretical value, 15.4 eV, from ground state H_2 to ground state H_2^+. This value, 16.1 eV, has frequently been observed. R.F.Barrow

539.19

17733 ERRATUM: POTENTIAL CURVES FOR HF AND LiH. R.J.Fallon, J.T.Vanderslice and E.A.Mason.
J. chem. Phys., Vol. 33, No. 3, 944 (Sept., 1960).

See Abstr. 5982, 11515 of 1960. The potential energy curves for HF and LiH previously calculated have been found to be in error. This erratum gives recalculated curves. The maximum correction is 2% for the highest levels. W.J.Orville-Thomas

539.19

17734 POTENTIAL CURVES FOR N_2, NO AND O_2. J.T.Vanderslice, E.A.Mason, W.G.Maisch and E.R.Lippincott.
J. chem. Phys., Vol. 33, No. 2, 614-15 (Aug., 1960).

Corrected working equations are used to obtain the potential energies of the bound states of N_2, NO and O_2. Results are similar to those already reported (Abstr. 4245 of 1960) except for the $A^3\Sigma_u^+$ and $B^3\Sigma_u^-$ states of O_2 and none of the conclusions drawn are affected by the new results. G.I.W.Llewelyn

539.19

17735 CORRELATION OF EXPERIMENTAL RESULTS FOR THE VIBRATIONAL RELAXATION OF NITRIC OXIDE. F.Robben, P.R.Monson and J.J.Allport.
J. chem. Phys., Vol. 33, No. 2, 630 (Aug., 1960).

Improved experimental techniques have enabled previous conflicting data (Robben, Abstr. 10176 of 1959, and Allport, Bull. Amer. Phys. Soc., Ser. II, Vol. 4, 370, 1959). on the anomalous relaxation time of heated NO to be reassessed. G.I.W.Llewelyn

539.19

17736 ULTRASONIC MEASUREMENT OF VIBRATIONAL, ROTATIONAL ISOMERIC, STRUCTURAL AND SHEAR RELAXATION IN ISOBUTYL BROMIDE. A.E.Clark and T.A.Litovitz.
J. Acoust. Soc. Amer., Vol. 32, No. 10, 1221-36 (Oct., 1960).

Ultrasonic measurements of the longitudinal absorption and velcoity and shear impedance were made over a large range of temperatures in the weakly associated liquid isobutyl bromide. Evidence was found for the coexistence of four different relaxation mechanisms. Above −50°C rotational isomeric relaxation exhibiting a single relaxation time was found. Vibrational relaxation a appears to be present with a relaxation time shorter than that u found in nonassociated liquids. The dispersion and absorption d below −125°C showed that both shear and structural relaxation effects were present. The former was related to a distribution relaxation times. The coexistence of these several relaxations i consistent with the concept that a weakly associated liquid shoul show relaxation behaviour typical of both strongly and nonassocia liquids.

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17737 SOUND DISPERSION IN ETHANE AND 1.1-DIFLUOR ETHANE. L.M.Valley and S.Legvold.
J. chem. Phys., Vol. 33, No. 2, 627-9 (Aug., 1960).

A method of interpreting data on double dispersion of ultrasound in ethane and 1-1 difluoroethane is presented. Results are compared with those of Lambert and Salter (Abstr. 9789 of 1960)
G.I.W.Llew

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17738 OUT-OF-PLANE CH VIBRATIONS IN SOME POLYNUCLEAR AROMATIC HYDROCARBONS. M.Randi
J. chem. Phys., Vol. 33, No. 3, 710-13 (Sept., 1960).

The out-of-plane CH bands in a number of polynuclear aro molecules are analysed. The CH bonds are considered as coupl oscillators. With each group of n neighbouring CH bonds an n subdeterminant and a single vibrational frequency was associate The method is applied to the methyl-1,2-benzanthracenes. Obser spectra agree with calculated frequencies well, and thus support idea that observed CH bands are caused by splitting the n identi coupled oscillators. The spectra of some other polynuclear aro hydrocarbons are also discussed.

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17739 COLLISIONAL DEACTIVATION OF VIBRATIONALL EXCITED sec-BUTYL-d_1 RADICALS PRODUCED BY CHEMICAL ACTIVATION.
R.E.Harrington, B.S.Rabinovitch and M.R.Hoare.
J. chem. Phys., Vol. 33, No. 3, 744-7 (Sept., 1960).

Vibrationally excited sec-butyl-d_1 radicals were produced b addition of D atoms to cis-butene-2. The radicals, which have a narrow range of internal energy E, undergo collisional stabiliza (S) or decomposition (D) with specific rate k_E. The ratio D/S wa studied as a function of pressure down to 0.005 mm at 25°. Usin calculated values of k_E, information is obtained about vibrational transitions upon collision of excited radicals with butene molecu under different assumptions regarding the form of the transition probability function. It is shown that in these cases the average energy transferred is at least 8.5 kcal/mole, and quite probably much more, which supports the conventional Lindemann collisio activation—deactivation assumption of strong collisions in this ca

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17740 VIBRATIONAL INTENSITIES AND BOND MOMENTS DEUTERATED METHANES.
R.E.Hiller, Jr and J.W.Straley.
J. molecular Spectrosc., Vol. 5, No. 1, 24-34 (July, 1960).

The intensities of infrared absorption bands in CH_3D, CH_2D_2, and CHD_3 have been measured by the method of Wilson and Wells (1946). These data yield alternate solutions for bond moment an bond derivative one of which appears to lie outside experimental error. The favoured solution is $\mu_{CH} = \pm 0.33$ debye and $(\partial\mu/\partial r)_{CH} = \mp 0.61$ debye/angstrom. The conclusion of Coulson (1942) that the CH bond moment has a polarity of C^+H^- leads one favour the upper combination of signs.

539

17741 WAVE NUMBERS, ROTATIONAL DISTORTION CONSTANTS AND THERMODYNAMIC PROPERTIES FOR NT_3, PT_3, AND AsT_3. S.Sundaram and F.F.Cleveland.
J. molecular Spectrosc., Vol. 5, No. 1, 61-4 (July, 1960).

The harmonic wave-numbers for NT_3, PT_3, and AsT_3 have be calculated by use of the potential energy constants obtained for t corresponding hydrides and deuterides in a previous investigatio by the authors. The anharmonicity factors and therefore the expected spectral frequencies have been evaluated. A first-orde perturbation calculation of the rotational distortion constants for the molecules has been made. The molar thermodynamic properties have been obtained from 100° to 1000°K for a rigid-rotor, harmonic-oscillator approximation at 1 atm pressure.

539.19

1 42 THEORY OF THE RADIO-FREQUENCY SPECTRA OF THE H_2^+ MOLECULE-ION. M Mizushima.

phys. J., Vol. 132, No. 2, 493-501 (Sept., 1960).
he possible r.f. spectrum of the H_2^+ molecule-ion is calculated.
owest rotational state (N = 0) is a para state, and there is no
fine structure, but the next state (N = 1) is an ortho-state and
into five levels because of the hyperfine interaction. The
encies and intensities of transitions among these five levels
alculated. The predicted resonance frequencies are 1438.0,
1, 1393.8, 1320.7, 1282.8, 44.2, and 37.9 Mc/s. The g-factor
ch level is also calculated.

539.19

743 THE MICROWAVE SPECTRUM OF QUINUCLIDINE.

L.G.Johnson.

em. Phys., Vol. 33, No. 3, 949-50 (Sept., 1960).
he spectrum is that of symmetric-top molecule, observed at
= 4 → 5, 5 → 6 and 6 → 7 transitions. Lines assigned to the
d state of the molecule, on account of their intensity and their
cement on cooling the cell to –20°C, yield a rotational constant
2 431.4 Mc/s. This is consistent with the accepted "cage"
ture, $N(CH_2CH_2)_3CH$. The centrifugal distortion constant, D_J,
± 2 kc/s. J.Sheridan

539.19

744 MICROWAVE SPECTRUM, STRUCTURE, DIPOLE MOMENT, AND INTERNAL ROTATION OF TRI-
HYL SILANE.

L.Pierce and D.H.Petersen.

em. Phys., Vol. 33, No. 3, 907-13 (Sept., 1960).
The microwave spectra of eleven isotopic species of trimethyl
e were measured and assigned. From the observed ground-
rotational constants the structural parameters of trimethyl
e are calculated to be CH 1.095 A; HCH 107° 36′; SiH 1.489 A;
1.868 A; CSiC 110° 10′. The equilibrium conformation is found
the one in which each methyl group staggers the SiH and ad-
nt SiC bond axes. Stark effect measurements yield a dipole
ent of 0.525 Debye. Relative intensities of torsional satellites
$D_3)_2CH_3SiH$ were measured and analysed to provide informa-
about the barrier to internal rotation in trimethyl silane.
ctural changes which accompany methylation and fluorination
ethyl silane are discussed.

539.19

745 HIGHLY PRECISE WAVELENGTHS IN THE INFRARED.

D.H.Rank, G.Skorinko, D.P.Eastman and T.A.Wiggins.

olecular Spectrosc., Vol. 4, No. 6, 518-33 (June, 1960).
Wavelengths of the 001-000, 002-000, 101-000, 01'0-000 bands
CN, and the 2-0, 1-0 bands of CO are tabulated in detail.
autions taken to ensure high accuracy of measurement and
ulation are summarized. G.I.W.Llewelyn

539.19

17746 INVESTIGATION OF THE RAMAN SPECTRA IN GASES AT LOW PRESSURES USING A PHOTOELECTRIC
THOD.

P.A.Bazhulin and Yu.A.Lazarev.

ka i Spektrosk., Vol. 8, No. 2, 206-13 (Feb., 1960). In Russian.
Reports a study of the intensities, widths, and profiles of the
tional and vibrational Raman lines of H_2, O_2, N_2, CO_2, CH_4 and
r mixtures with A and He at pressures of 1-10 atm and tempera-
s of 30-250°C. The collision cross-sections deduced from
dening of the rotational Raman lines at T = 300°K were: 4.2 A
O_2, 4.1 A for N_2, 9 A for CO_2, and < 1 A for H_2. A.Tybulewicz

539.19

7747 A THEORY OF THE INTENSITIES OF THE INFRARED MOLECULAR SPECTRA. VI. BF_3, NF_3, SiF_4 AND SF_6.

.Sverdlov.

ka i Spektrosk., Vol. 8, No. 2, 183-90 (Feb., 1960). In Russian.
For previous work see Abstr. 4203 of 1960. Reports a calcula-
of the electro-optical parameters of BF_3, NF_3, SiF_4 and SF_6 in
first valence-optical approximation using the published
nsities of the infrared bands of these molecules. The dipole
nents of the X—F bonds were found to rise with increase of the
erence of the electronegativities of the X and F atoms.
A.Tybulewicz

539.19

17748 PURE ROTATIONAL ABSORPTION OF OZONE IN THE REGION 125-500 MICRONS.

.Gebbie, N.W.B.Stone and C.D.Walshaw.

Nature (London), Vol. 187, 765-7 (Aug. 27, 1960).

The spectra, which were derived from interferometric measurements, showed the Q branches of ozone, and some other lines — several of which correspond to water lines. The region 125-200μ overlaps with the work done by Danti and Lord (Abstr. 6729 of 1959) with whose results there is agreement. Several lines at the other end of the spectrum correspond to unidentified lines in the solar spectrum. G.H.C.Freeman

539.19

17749 INDUCED Q BRANCH IN THE VIBRATION—ROTATION SPECTRUM OF HCl PRESSURIZED WITH Ar.

G.C.Turrell, H.Vu and B.Vodar.

J. chem. Phys., Vol. 33, No. 1, 315-16 (July, 1960).

Approximate experimental values of extinction coefficients at the maxima of the Ar pressure-induced Q branch of the fundamental vibration—rotation band of HCl at two temperatures are reported and compared with theory. An approximate theoretical expression for the extinction coefficient of the collision broadened induced Q branch is cited. From the comparison of theoretical with experiment numerical results it is concluded that the observed induced Q branch can be attributed to collision overlap effects, and that effects on the Q branch arising from induction by the quadrupole moment of the diatomic molecule are negligible. P.M.Parker

539.19

17750 INFRARED SPECTRA OF SOME UNSTABLE ISOMERS OF N_2O_4 AND N_2O_3.

I.C.Hisatsune, J.P.Devlin and Y.Wada.

J. chem. Phys., Vol. 33, No. 3, 714-19 (Sept., 1960).

The temperature dependence of the infrared spectra of N_2O_4 and N_2O_3 in the solid phase at liquid-nitrogen temperatures was investigated. From the spectra of both N^{14} and N^{15} isotopic molecules, absorption bands which may be assigned to unstable isomers of these nitrogen oxides were identified. A reasonable interpretation of these absorption bands can be made by assuming the existence of two unstable forms of N_2O_4 and one of N_2O_3.

539.19

17751 FINE STRUCTURE IN THE LINES OF THE $2\nu_3$ BAND OF METHANE.

D.H.Rank, D.P.Eastman, G.Skorinko and T.A.Wiggins.

J. molecular Spectrosc., Vol. 5, No. 1, 78-82 (July, 1960).

The wavelengths of the lines of the $2\nu_3$ band have been remeasured under higher resolution than was formerly possible. Lines which were not resolvable by means of the grating alone but which were obviously complex were examined with a Fabry—Perot etalon, the resolving power of which was 400 000. By means of the line contours obtained with the interferometer it was possible to analyse many of the complex lines into their probable fine structures.

539.19

17752 THE RAMAN SPECTRUM OF METHANE.

M.A.Thomas and H.L.Welsh.

Canad. J. Phys., Vol. 38, No. 10, 1291-303 (Oct., 1960).

The Raman spectrum of CH_4 was obtained with a spectral resolution of ~0.3 cm^{-1}, and rotational analyses of the ν_2 and ν_3 bands were carried out. The B_0 values obtained from the ν_2 and ν_3 bands are 5.240 ± 0.002 and 5.2406 ± 0.0011 cm^{-1}, respectively; the value of r_0 determined from the latter is 1.09403 ± 0.00016 A. The rotational levels of the v = 1 state of ν_2 are double with B_1 values of 5.313 and 5.379 cm^{-1}. The rotational levels of the v = 1 state of ν_3 do not follow the theoretical formulae exactly; the deviations for the 13 branches observed can be expressed by using three different B_1 values, 5.178, 5.195, and 5.212 cm^{-1}. The value of ζ_3 is 0.054. The band origins are: $\nu_1 = 2916.7$, $\nu_2 = 1533.6$, and $\nu_3 = 3018.9$ cm^{-1}.

539.19

17753 INFRARED AND RAMAN SPECTRA OF C_2Br_3D.

J.R.Scherer, J C.Evans and J.Overend.

J. chem. Phys., Vol. 33, No. 1, 314-15 (July, 1960).

Reports the vibrational spectrum of tribromoethylene-d. Vibrational assignments are made with the aid of calculations to be reported later and by reference to spectra of related molecules. A description of the preparation of the compound is given.
P.M.Parker

539.19

17754 RAMAN SPECTRUM AND STRUCTURE OF PERCHLORYLFLUORIDE.

F.X.Powell and E.R.Lippincott.

J. chem. Phys., Vol. 32, No. 6, 1883 (June, 1960).

The specimen was condensed at −50° C and the spectrum photographed, using λ = 4358 A. Wave-numbers (410-1460 cm^{-1}) are tabulated and assignments are in conformity with a C_{3v} symmetry.

G.F.Lothian

539.19

17755 FAR INFRARED SPECTRUM OF TRIMETHYLENE OXIDE. A.Danti, W.J.Lafferty and R.C.Lord.

J. chem. Phys., Vol. 33, No. 1, 294-5 (July, 1960).

Trimethylene oxide (TMO) was investigated in the 40-600 cm^{-1} region. A series of sharp strong peaks (80-140 cm^{-1}) is associated with the puckering vibrations of the TMO ring, vibrational transitions for this mode giving the intense Q branch maxima observed. The energy levels for this series lead to the prediction of two series of overtone bands which can be associated with absorptions at 250-300 cm^{-1} and 390-410 cm^{-1}.

D.L.Greenaway

539.19

17756 DOUBLE MINIMUM VIBRATION IN TRIMETHYLENE OXIDE. S.I.Chan, J.Zinn and W.D.Gwinn.

J. chem. Phys., Vol. 33, No. 1, 295-6 (July, 1960).

The potential function for the ring-puckering vibration of trimethylene oxide (TMO) shows a double minimum. The function giving the best fit to the infrared data of Danti, Lafferty and Lord (preceding abstract) contains a quartic term added to terms corresponding to an harmonic oscillator perturbed by a hump. This expression gives a nearly perfect fit to the experimentally observed vibration—rotation interaction of TMO.

D.L.Greenaway

539.19

17757 VISIBLE ABSORPTION SPECTRUM OF BENZOQUINONE.

R.S.Singh.

Indian J. Phys., Vol. 33, No. 9, 376-87 (Sept., 1959).

The spectrum was studied in the vapour state. The bands which lie in the region of 4100-5000 A consist of eight main groups developed at 100° C in a 50 cm cell. About 175 bands are measured in this region. These bands are very sharp, many of them having double and triple heads. One marked feature is the appearance of companion bands with separations of 36 cm^{-1} lying on the shorter wave-length side. An analysis has been proposed assigning the bands as due to $n-\pi$ ($Au \leftarrow Ag$) transition.

539.19

17758 POLARIZATION OF LUMINESCENCE OF A HARMONIC OSCILLATOR. V.P.Gribkovskii and B.I.Stepanov.

Optika i Spektrosk., Vol. 8, No. 2, 176-82 (Feb., 1960). In Russian.

Gives a quantum-mechanical calculation of polarization of luminescence of a system of particles with two energy levels and of an assembly of harmonic oscillators. It is found that polarization of luminescence of a system of two energy levels, usually represented by a classical dipole, is less than the polarization of luminescence of harmonic oscillators and depends on the intensity of the exciting radiation and the ambient medium temperature. Particles with two energy levels can be represented by a classical dipole only at low excitation energies and low temperatures.

A.Tybulewicz

539.19

17759 KINETIC ABSORPTION SPECTRA RECORDED THROUGH FLASH-HEATED GRIDS. L.S.Nelson and N.A.Kuebler.

J. chem. Phys., Vol. 33, No. 2, 610-11 (Aug., 1960).

Grids of pyrolysed rayon filament inside a gas cell may be heated by radiation from a flash discharge and so thermally generate free radicals. CH_3 radicals have been so formed in CH_4.

G.F.Lothian

539.19

17760 FLASH-ABSORPTION SPECTROSCOPY OF FREE RADICALS IN SHOCK WAVES. R.M.Ikeda.

J. chem. Phys., Vol. 33, No. 1, 311-12 (July, 1960).

Mixtures of SO_2/argon and C_2H_2/O_2/argon have been subjected to shock waves and the free radicals formed studied quantitatively at known temperatures using a quartz spectrograph.

G.I.W.Llewelyn

53

17761 SPECTRUM OF K_2ReCl_6.

J.C.Eisenstein.

J. chem. Phys., Vol. 32, No. 6, 1887-8 (June, 1960).

The absorption peaks at 14 200, 15 700, and 16 100 cm^{-1}, pre viously attributed to transitions from the $^4A_2$ ground state to eit ^2E, $^2T_1$, or $^2T_2$ states, are now assigned to $^2T_2$ transitions. The fact the 16 100 cm^{-1} absorption is pressure induced supports this int pretation.

D.L.Green

53

17762 CALCULATION OF THE ENERGIES OF THE s-STA IN THE H_2^+ MOLECULE-ION. R.Gáspár.

Acta phys. Hungar., Vol. 11, No. 3, 295-7 (1960).

Examines a discrepancy between the results of Abstr. 751 a 7452 of 1959, and shows that the approximation contained in the former is much worse than that in the latter, confirming that th united-atom approximation is poorly convergent for H_2^+.

J.Haw,

53

17763 THE EVALUATION OF THE ELECTRONIC TRANSI MOMENT FOR THE $b^3\Sigma^+ - a^3\pi$ SYSTEM OF CO.

N.R.Tawde and B.S.Patil.

Indian J. Phys., Vol. 33, No. 12, 505-10 (Dec., 1959).

The integrated intensities obtained by Barrow, Gratzer and Malherbe (Abstr. 1177 of 1957) for CO($b^3\Sigma - a^3\pi$) have been used determine the dependence of electronic transition moment $R_e(r)$ upon the internuclear distance r, with the aid of Frank—Condon factors $q_{v'v''}$ and $\bar{r}_{v'v''}$ (r-centroids). For this purpose, the r-centroids have been calculated independently and the relation connecting R_e and $\bar{r}$ evolves in the form $R_e = C(1-0.6433\bar{r})$ for this system. The theoretical intensities under the assumptions R_e as constant are then corrected for variation of R_e with $\bar{r}$, by above relation and they have been discussed in the light of the available integrated intensity data. It is noticed that disharmony between theory and experiment is considerably reduced as a res of the introduction of $R_e(r)$ factor.

53

17764 THE $^1\Sigma^+$ EXCITED STATES OF CARBON MONOXID

H.Lefebvre-Brion, C.M.Moser and R.K.Nesbet.

J. chem. Phys., Vol. 33, No. 3, 931-2 (Sept., 1960).

The effect of (i) the use of several L-shell orbitals with diff exponents, and (ii) the use of M-shell orbitals in an LCAO-MO-S calculation of the excited states of CO indicate that the addition M shell orbitals improves agreement between theory and experi much more than doubling the number of L-shell functions.

W.J.Orville-Tho

539

17765 EXCITED ELECTRONIC STATES OF LITHIUM AND SODIUM MOLECULES.

R.F.Barrow, N.Travis and C.V.Wright.

Nature (London), Vol. 187, 141-2 (July 9, 1960).

The rotational analyses of bands belonging to two ultraviolet systems of both molecules is reported. The constants, in cm^{-1},

	State	T_e	ω_e	$x_e\omega_e$	B_e	$10^3\alpha_e$
Li_2^7	$D\,^1\Pi_u$	≤ 34 140	205	-	0.465	-
	$C\,^1\Pi_u$	30 549	237.9	3.33	0.5076	9.64
Na_2	$D\,^1\Pi_u$	33 440	110	0.5	0.1185	1
	$C\,^1\Pi_u$	29 393	117.3	0.55	0.12815	0.84

The energies and products of dissociation of these states are dis cussed and it is suggested that the states B, C, D form the Rydbe series $(s\sigma_g, np\pi_u)^1\Pi_u$. If so, the ionization potential of Na_2 is ab 39 300 cm^{-1}, so that, since i.p. (Na) = 41 450 cm^{-1}, D(Na_2^+) is gre than D(Na_2) by about 2150 cm^{-1} or 35%.

R.F.Bar

53

17766 A π ELECTRON INTERACTION POTENTIAL FUNC FOR $Ni(CO)_4$ AND RELATED MOLECULES. L.H.Jo

J. molecular Spectrosc., Vol. 5, No. 2, 133-47 (Aug., 1960).

In order to reduce the number of force constants to the num of frequencies for tetrahedral $X(YZ)_4$ molecules, thus making th normal vibration prolem solvable, a specialized quadratic poten function was developed. This function is based on the hypothesis he interaction constants arise mainly from interatomic inter- ns of the π electrons and π orbitals. For this reason it is l a π interaction valence force field (πIVFF). The specific case CO)$_4$ is treated and the force constants obtained are shown to ite reasonable.

539.19

67 ON THE ASSIGNMENT OF THE LOWEST TRIPLET STATE IN BENZENE. A.C.Albrecht.

em. Phys., Vol. 33, No. 3, 937 (Sept., 1960).

t is suggested that the major part of the electric-dipole edness in the phosphoresence of benzene is achieved by nic mixing of $^3B_{1u}$ and $^3E_{1u}$ states. The $^1A_{1g}$—$^3B_{1u}$ intensity is n from the $^1A_{1g}$—$^1E_{1u}$, $^1A_{2u}$ intensity through spin-orbit coupling. is shown formally by employing vibronic theory using zeroth- functions in which spin states are mixed. The results of pre- ary experiments on the polarized phosphorescence of benzene rigid glass and of the polarized phosphorescence of p-dimethoxy- ene show that $^1A_{1g}$—$^1A_{2u}$ (out of plane) accounts for a substantial ortion of the observed intensity. T.E.Peacock

539.19

768 JAHN—TELLER DISTORTIONS IN CYCLOBUTADIENE, CYCLOPENTADIENYL RADICAL, AND BENZENE TIVE AND NEGATIVE IONS. L.C.Snyder.

em. Phys., Vol. 33, No. 2, 619-21 (Aug., 1960).

Molecular orbital calculations of energies, bond lengths and ron spin densities are made for these molecules in symmetric gurations and also in distorted configurations, the latter being in which the energy is a minimum or passes through a saddle . The results are in qualitative agreement with those of Liehr schrift für physikalische Chemie (Frankfurt), Vol. 9, 338, 1956]. the assumptions made, the properties calculated are the same oth $C_6H_6^+$ and $C_6H_6^-$, and for these the minimum energy is al/mole below the energy of the saddle point. The electron resonance spectrum of $C_6H_6^-$ shows this difference to be in- cient to localize the spin density on four rather than six equi- t carbon atoms, at room temperature. J.Sheridan

539.19

769 ELECTRONIC SPECTRA OF DIMERS: DERIVATION OF THE FUNDAMENTAL VIBRONIC EQUATION.

tkowski and W.Moffitt.

em. Phys., Vol. 33, No. 3, 872-5 (Sept., 1960).

The Hamiltonian describing the vibronic states of a dimer ed by two identical molecules is derived. The monomeric units assumed to couple by resonance forces only and to have different librium positions in the ground and excited states. The com- ion of these two effects is formulated mathematically. The g coupling case occurs when the resonance forces dominate: veak coupling case arises when the effect of the change of librium positions dominates.

539.19

7770 CALCULATION OF THE POLARIZABILITY OF MOLECULES WITHIN THE FRAMEWORK OF THE TALLIC MODEL. Yu.N.Zhivlyuk.

ika i Spektrosk., Vol. 8, No. 3, 421-3 (March, 1960). In Russian.

Polarizability of molecules within the framework of the allic model is normally calculated on the assumption of an nitely deep potential well. The present note shows that a ntial well of finite depth can be assumed in calculations of rizability and illustrates the use of a finite well on butadiene. A.Tybulewicz

539.19

7771 BOND LENGTHS AND NUCLEAR QUADRUPOLE COUPLING IN VINYL HALIDES. E.Spinner.

hem. Phys., Vol. 33, No. 2, 611-12 (Aug., 1960).

It is argued that the shortening of carbon—halogen bonds in l halides, relative to those in alkyl halides, and the non- ndrical field gradients at the halogen nuclei, as reflected in r quadrupole couplings, do not demand double bond character he carbon halogen bonds. Reasons are given for preferring an lanation in terms of intramolecular steric repulsions and London es. J.Sheridan

539.19

7772 BOND LENGTHS AND NUCLEAR QUADRUPOLE COUPLING IN VINYL HALIDES. E.B.Wilson, Jr.

hem. Phys., Vol. 33, No. 2, 612-13 (Aug., 1960).

A comment on the paper by Spinner (preceding abstract). The concept of conjugation should not be rejected entirely, although other factors are clearly also present. Some difficulties associated with the theory of lack of cylindrical symmetry in single bonds are pointed out. J.Sheridan

539.19

17773 PARAMAGNETIC RESONANCE ABSORPTION OF TRI- PHENYLMETHYL. D.B.Chesnut and G.J.Sloan.

J. chem. Phys., Vol. 33, No. 2, 637-8 (Aug., 1960).

Using a 10^{-3} molar solution of the radical in toluene at temperatures between $-20°$ and $-50°$C, more than 100 of the 196 theoretically possible hyperfine lines due to coupling of the electron with the protons were resolved. The para-proton coupling constant was found to be 2.77 G. Two other constants determined as 2.53 and 1.11 G could not be unambiguously assigned between the ortho- and meta-protons. E.F.W.Seymour

539.19

17774 HYPERFINE STRUCTURE OF E.S.R. SIGNALS IN PHENOTHIAZINE PERCHLORATE (SEMIQUINONE) AND PHENOTHIAZINE PERBROMIDE (QUINONE).

G.Lanzi, G.Siragusa and L.Zanotti.

Nuovo Cimento, Vol. 16, No. 6, 1155-7 (June 16, 1960).

A preliminary announcement is made of the observation of the hyperfine structure. A detailed explanation of it awaits further work. An explanation is given of possible reasons for the observation of e.s.r. in quinone, which was expected to be diamagnetic. J.M.Baker

539.19

17775 ORIENTATION DEPENDENCE OF MAGNETIC HYPERFINE STRUCTURE IN FREE RADICALS. S.M.Blinder.

J. chem. Phys., Vol. 33, No. 3, 748-52 (Sept., 1960).

The anisotropic part (B term) of the spin Hamiltonian for a free radical is averaged to zero when there is rapid molecular tumbling. Otherwise, it combines with the isotropic part (A term) to produce orientation-dependent hyperfine splittings in e.s.r. spectra. In the high-field case, the electron is strongly coupled to the external field. The nucleus, however, is effectively coupled to the electron's tensor field. Consequently, the two spins have, in general, different axes of quantization. Applying first-order perturbation theory, expressions are derived for the orientation dependence of the resonance in a single crystal and for the line shape in a powder.

539.19

17776 ELECTRON-SPIN RESONANCE OF ELECTROCHEMICALLY GENERATED FREE RADICALS. ISOMERIC DINITROBENZENE MONONEGATIVE IONS.

A.H.Maki and D.H.Geske.

J. chem. Phys., Vol. 33, No. 3, 825-32 (Sept., 1960).

The mononegative ions of meta-, ortho- and para-dinitrobenzene were prepared in acetonitrile by controlled potential electrolysis within a microwave cavity and their electron spin resonance observed. The radical spectra exhibit hyperfine structure due to the isotropic magnetic interaction of the unpaired electron with the nitrogen and ring proton nuclear moments. Coupling constants were obtained with the aid of deuterium substitutions in the parent molecule. The nitrogen hyperfine coupling constants for the isomeric meta, ortho, and para anions were found to be 4.68, 3.22, and 1.74 G, respectively, and were identical for each of the two nitrogen nuclei of a given radical. Proton coupling constants range between 0.42 and 4.19 G. The larger total hyperfine width of the meta-dinitrobenzene anion compared with the ortho and para isomers is ascribed to the existence of negative spin density in the π system of the first-mentioned radical and to the possibility of quinonoid resonance in the others which places considerable unpaired spin density in the oxygen nonbonding orbitals.

539.19

17777 DOUBLE RESONANCE EXPERIMENTS ON THE $(SO_3)_2NO^{--}$ FREE RADICAL. J.H.Burgess.

J. Phys. Radium, Vol. 19, No. 11, 845-9 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). Double resonance experiments have been carried out on dilute aqueous solutions of the paramagnetic ion $(SO_3)_2NO^{--}$ in magnetic fields around 30 Oe. This free radical exhibits a well resolved hyperfine structure with a zero field splitting of 54.7 Mc/s. Radiation of saturating intensity was applied near the resonance frequency of one hyperfine component. At the same time the energy absorption near a second resonance frequency was observed by means of a Pound—Knight type detector operating at a low r.f.-intensity level.

Resonances were displayed as a function of magnetic field for various applied r.f. frequencies and for several intensities of the saturating radiation. In cases where there was an energy level common to the two transitions excited by the applied radiations, a splitting of the resonance line occurred. The positions and intensities of the two maxima depended in a detailed manner on the applied frequencies, the strength of the saturating field, the relaxation times of the disulphonate ion and on the behaviour of the energy levels with d.c. magnetic field intensity. In cases where there is no common energy level, no effects of the saturating radiation were observed. An analysis, based on the density matrix equation $d\rho/dt = 1/i\hbar[H,\rho] = 1/T(\rho-\rho_0)$, where ρ_0 is the normalized Boltzmann factor appropriate to the energy of the system in the static magnetic fields, leads to a result for the susceptibility which agrees closely with the observations.

539.19

17778 SPIN DENSITIES IN ORGANIC FREE RADICALS.

T.H.Brown, D.H.Anderson and H.S.Gutowsky.

J. chem. Phys., Vol. 33, No. 3, 720-6 (Sept., 1960).

The proton hyperfine constants obtained from proton magnetic resonance spectra of polycrystalline free radicals and from valence bond calculations of π-orbital spin densities are compared for the free radicals α,α'-diphenyl-β-picryl hydrazyl (DPPH), and tris-p-chlorophenylaminium perchlorate (TPPAP). Two lines are observed in the proton magnetic resonance spectra, one shifted upfield and one downfield from the normal resonance frequency. These are assigned to the ortho and para protons, and the meta protons of the free radicals, respectively. Though the agreement between theory and experiment is not quantitative for the hyperfine constants, the theoretical and experimental ratios of hyperfine constants agree within experimental error. This serves to verify the existence of positive and negative spin densities and the signs of some of the relationships involved.

539.19

17779 SPIN–LATTICE RELAXATION AND MOLECULAR STRUCTURE. I. THE MAJOR IMPORTANCE OF INTERMOLECULAR CONTRIBUTIONS.

F.A.Bovey.

J. chem. Phys., Vol. 32, No. 6, 1877-8 (June, 1960).

Reports measurements of proton spin–lattice relaxation times at room temperature for mesitylene ring and methyl protons, tetramethylsilane, cyclohexane, and benzene at varying concentrations in carbon disulphide. Relaxation times were inferred by r.f. saturation and subsequent timing of the regrowth of the signals after reduction of the r.f. power level. From a semiqualitative analysis of the results it is concluded that relative contributions of intermolecular and intramolecular dipole–dipole interactions to the spin–lattice relaxation time depend strongly on molecular structure, with the intramolecular interaction the dominant contribution for the methyl group protons. It is pointed out that this conclusion contradicts that of Reilly et al. (Abstr. 588, 7271 of 1957). P.M.Parker

539.19

17780 N.M.R. STUDIES ON MIXED BORON HALIDES. DETECTION OF THE NEW HALIDE BBrClF.

T.D.Coyle and F.G.A.Stone.

J. chem. Phys., Vol. 32, No. 6, 1892-3 (June, 1960).

Presents F^{19} high resolution spectra of boron halide mixtures at room temperature. Of particular interest is the spectrum of the ternary mixture $BF_3 + BCl_3 + BBr_3$ in that there is present a quartet attributable to the hitherto unreported BBrClF. Chemical shifts of F^{19} relative to BF_3 and B^{11}–F spin coupling constants are given for the compounds of the ternary mixture. P.M.Parker

539.19

17781 F^{19} SPECTRA OF PHOSPHORUS (V) FLUORIDES.

W.Mahler and E.L.Muetterties.

J. chem. Phys., Vol. 33, No. 2, 636 (Aug., 1960).

From an analysis of the F^{19} high resolution nuclear magnetic resonance spectrum of CF_3PF_4, it is inferred that the surprising spectroscopic equivalence of all fluorine nuclei in the bipyramidal PF_5 molecule is due to an exceedingly small chemical shift between axial and equatorial fluorine nuclei. E.F.W.Seymour

539.19

17782 H^1–P^{31} SPIN COUPLING IN PHOSPHATE ESTERS.

G.O.Dudek.

J. chem. Phys., Vol. 33, No. 2, 624-5 (Aug., 1960).

The addition of more electron-releasing substituents, R, in compunds $(R{-}CH_2O)_3P{=}O$ is known to decrease the H^1–P^{31} spi spin coupling constant in a manner which is correlated with the value of the Taft σ^* function of the substituent. Results are repo which show that the correlation does not extend to electron-withdrawing substituents. E.F.W.Sey

53

17783 NUCLEAR MAGNETIC RESONANCE SPECTRA OF SYSTEMS OF THE A_3B_2C TYPE: PROTON MAGNE RESONANCE SPECTRA AND THE ABSOLUTE SIGNS OF THE PROTON–PROTON SPIN COUPLING CONSTANTS IN ETHYL ACETYLENE AND ETHYL MERCAPTAN.

P.T.Narasimhan and M.T.Rogers.

J. chem. Phys., Vol. 33, No. 3, 727-33 (Sept., 1960).

The high-resolution proton magnetic resonance spectra of e acetylene and ethyl mercaptan were studied at 40 and 60 Mc/s. Theoretical analysis of these spectra systems of the A_3B_2C type enables one to determine the relative signs of the proton–proto spin coupling constants in these molecules. It is thus shown tha the spin coupling constants $J_{CH_3-CH_2}$ and J_{CH_2-CH} are of opp sign in ethyl acetylene, while $J_{CH_3-CH_2}$ and J_{CH_2-SH} in ethyl mercaptan are of the same sign. Making use of the results of th valence bond theory regarding the absolute sign of $J_{CH_3-CH_2}$ th present analysis has been made possible determinations of the absolute sign of J_{CH_2-CH} and J_{CH_2-SH} in ethyl acetylene and ethyl mercaptan, respectively.

5

17784 ELECTRON COUPLING OF NUCLEAR SPINS. IV: TEMPERATURE DEPENDENCE IN SUBSTITU ETHANES.

J.C.Schug, P.E.McMahon and H.S.Gutowsky.

J. chem. Phys., Vol. 33, No. 3, 843-50 (Sept., 1960).

For previous work, see Abstr. 7454 of 1959. The proton–proton coupling constant, $A_{HH'}$, in H–C–C'–H' groups is know depend upon the dihedral angle, ϕ. Previous valence-bond calcu lations by Karplus (Abstr. 6201 of 1959) have given the result th $A_{HH'} \cong A_0 \cos^2\phi + B$. This relation is used to estimate the effe upon the average coupling constant of torsional vibrations and r orientations about the C–C' bond. For substituted ethanes, it is found that torsional vibrations produce a modest temperature de pendence, of opposite sign for the trans and gauche coupling. H ever, for molecules in which the potential function, $V(\phi)$, has th fold symmetry, rotational averaging leads to a cancellation of th vibrational effects, giving a temperature independent value, $\langle A_H$ for the average coupling. This prediction has been verified in e periments on ethyl nitrate for which $\langle A_{HH'}\rangle$ was found to have a constant value of 6.92 c/s over a 100° temperature range. When there is an energy difference, ΔE, between trans and gauche for ΔE determines the sign and magnitude of the temperature depen of $\langle A_{HH'}\rangle$; however, corrections for the vibrational effects appe desirable if accurate values of ΔE are to be obtained from such periments. The temperature dependence of $\langle A_{HH'}\rangle$ could not be calculated analytically for any but the simplest potential functio and simplest approximations to the torsional motions. However was found that the detailed form of $V(\phi)$ has but a slight effect o the results. $\langle A_{HH'}\rangle$ is, of course, more sensitive to the functio form of $A(\phi)$.

53

17785 POTENTIAL ENERGY BARRIER TO ROTATION IN METHYL NITRITE MEASURED BY P.M.R.

P.Gray and L.W.Reeves.

J. chem. Phys., Vol. 32, No. 6, 1878-80 (June, 1960).

High resolution study of proton resonance in liquid methyl nitrite is reported for a range of temperatures from room tempe ture to about −80°C. At the higher temperatures a single resona line is observed, and line width considerations then give a potent barrier to rotation of 10500 ± 2000 cal/mole. At the lower temp tures two resonance peaks are observed which allow evaluation relative abundance of the cis to trans isomers as 0.377 ± 0.025 −52°C. The temperature at which evidence of the second resona peak appears ("coalescence" temperature) is −38 ± 1°C. See Ab 7200 of 1959. P.M.Pa

53

17786 QUANTUM-MECHANICAL APPROXIMATIONS TO CHEMICAL SYSTEMS.

R.E.Glick and D.F.Kates.

J. chem. Phys., Vol. 33, No. 1, 308 (July, 1960).

In calculating the molecular susceptibility of ethylene it is e bent bond equivalent orbital description is more appropriate e σ-π structure. It is suggested however, that both sentations are correct and that a resonance description is ed with the equivalent orbital distribution more appropriate w frequency and the σ-π for higher frequency phenomena.

R.A.Ballinger

539.19

787 NOTES ON A BESK PROGRAMME FOR MOLECULAR ONE-ELECTRON TWO-CENTER INTEGRALS AND DIAGRAMS SHOWING THE DEPENDENCE OF THESE GRALS ON THE ORBITAL EXPONENTS. S.Flodmark.

Fys., Vol. 17, Paper 4, 81-8 (1960).

hese integrals can be calculated by this programme for all inations of Slater orbitals of the K,L and M shells. Details of reparation of the input parameter tape, and curves for the dence of some of the integrals on RZ, are given.

J.Hawgood

539.19

788 IMPROVED MOLECULAR ORBITALS AND THE VALENCE-BOND THEORY. A.C.Hurley.

em.Phys., Vol. 33, No. 1, 301-2 (July, 1960).

xamines the process of dissociation of the state B $^1\Sigma_u^+$ of H_2 described by the improved MO wave-function of Abstr. 8399 of and its relation to the VB description. J.Hawgood

539.19

789 BOND POLARIZABILITY COMPONENTS. G.W.Chantry and R.A.Plane.

em. Phys., Vol. 33, No. 2, 634-5 (Aug., 1960).

Raman intensity data are used, in conjunction with the theory olkenstein (C.R. Acad. Sci. U.R.S.S., Vol. 32, 185, 1941), lculate bond polarizability components for CCl_4. The deriva- of the bond anisotropy and of the polarizability components also computed, and probably give more information about the ing electrons than do the polarizabilities themselves. The otropies of polarizability derivatives are briefly discussed for ous types of bond.

J.Sheridan

539.19

790 VALENCE-BOND RESONANCE STRUCTURES FOR A TRIPLET STATE. A.D.McLachlan.

em. Phys., Vol. 33, No. 3, 663-4 (Sept., 1960).

Pauling's rules for calculating the singlet ground state of a ecule by the valence-bond method are extended to deal with et states.

539.19

7791 ON THE INTERPRETATION OF SLATER'S APPROXIMATION OF ATOMIC ORBITALS.

łebiewski and K.Zalewski.

phys. Polon., Vol. 17, No. 2-3, 199-200 (1958).

Brief article which explains that some authors of quantum nistry monographs use one-electron hydrogen-like wave- ations in a careless manner.

P.M.Parker

539.19

17792 ON THE ELECTRON DENSITY DISTRIBUTION IN MOLECULES. W.Kołos.

a phys. Polon., Vol. 17, No. 2-3, 201-2 (1958).

Brief article pointing out some semi-qualitative features of -electron density distributions based on correlated one-electron nic orbitals.

P.M.Parker

539.19

7793 CONCISE METHOD FOR FORMING TWO-CENTER INTEGRALS OF OPERATORS. J.M.Robinson.

hem. Phys., Vol. 33, No. 3, 734-6 (Sept., 1960).

Two-centre integrals of operators for Slater-type atomic orbitals concisely expressed in terms of O functions which arise directly m the integral represtation in spherical polar coordinates. The O ctions are expressible in terms of A and B functions which lend mselves nicely to machine programmes. Their greatest asset heir convenient correlation of A and B functions with Slater-type mic orbitals and operators expressed in spherical polar coordinates. mples are given for dipole-moment and quadrupole-moment rators.

539.19

17794 ORBITAL RADII AND THE DEPENDENCE OF BOND LENGTH UPON IONICITY, HYBRIDIZATION, AND BOND ORDER. J.K.Wilmshurst.

J. chem. Phys., Vol. 33, No. 3, 813-20 (Sept., 1960)

Expressions for the dependence of hybrid orbital radii upon the constituent atomic orbitals and the ionicity of the bond to be formed are given. Using accurate bond-length data (±0.005 A) and a suitable expression for bond ionicity, atomic orbital radii have been obtained for the elements of the first four periods (other than transition metals). These radii can be used to calculate bond lengths in lone molecules, ionic crystals or metals or, alternatively, the experimental internuclear distance can be used in the same manner as the nuclear quadrupole coupling constant to describe the bond parameters in some detail.

539.19

17795 DIAMAGNETISM AS A TEST OF WAVE FUNCTIONS FOR SOME SIMPLE MOLECULES. K.E.Banyard.

J. chem. Phys., Vol. 33, No. 3, 832-6 (Sept., 1960).

A theoretical study is made of the diamagnetism of some simple molecules in a gaseous form, attention being mainly devoted to the "neon-like" series Ne, H_2O, NH_3, and CH_4. In this way an attempt is made to gain insight into the way in which the radial electron density distribution within the molecules is influenced, firstly, by the allowance of exchange effects and secondly, by the inclusion of angular terms which must be accounted for in any "physically real" description of the electron density. In general, it is found that exchange effects cause the radial density distribution to contract, while the inclusion of angular terms results in the subsequent radial electron density becoming more diffuse.

539.19

17796 SOME INTRA-ATOMIC CORRELATION CORRECTION STUDIES. M.Krauss and B.J.Ransil.

J. chem. Phys., Vol. 33, No. 3, 840-2 (Sept., 1960).

The applicability of the "intra-atomic correlation correction" formulation of Hurley (Abstr. 1446 of 1956, 2625 of 1958) is discussed. It is shown that accurate molecular bond energies cannot be obtained with the usual restricted basis set without employing another empirical procedure, although it may be possible to obtain accurate excitation energies.

539.19

17797 DANGERS OF THE "AVERAGE ENERGY APPROXIMATION" IN PERTURBATION THEORY. A.D.McLachlan. "AVERAGE ENERGY APPROXIMATION" IN SPIN-COUPLING CALCULATIONS. M.Karplus.

J. chem. Phys., Vol. 32, No. 4, 1263 (April); Vol. 33, No. 3, 941-2 (Sept., 1960).

McLachlan points out that the "average energy approximation" can lead to false conclusions when used to simplify second-order perturbation theory calculations.

Karplus states that under certain circumstances, it can be justified. It is used in his paper to discuss the calculation of spin-orbit coupling constants in molecules where the singlet and triplet eigenfunctions of interest can be represented in terms of a localized bond structure. However, for complicated molecules, particularly those for which delocalization is significant, considerable care is necessary in the use of the average energy approximation.

T.E.Peacock

539.19

17798 CONSIDERATIONS ON THE LIMITS OF APPLICABILITY OF THE METHOD OF ATOMS IN MOLECULES.

E.Abate.

Nuovo Cimento, Vol. 16, No. 1, 190-3 (April 1, 1960). In Italian.

Calculations on the excitation energies of the lithium molecule using this method suggest that it is not applicable to simple molecules.

J.Hawgood

539.19

17799 THE COMPONENTS OF THE POLARIZABILITY TENSOR OF THE DOUBLE BONDS C=C AND C=O.

M.F.Vuks.

Optika i Spektrosk., Vol. 8, No. 6, 877-8 (June, 1960). In Russian.

The polarizability tensor of double bonds is always assumed to be axially symmetrical, although this is not always true. To check whether this is true for the C=C and C=O bonds, a method of calculation and actual results are given for all three principal components of the polarizability tensor of these bonds. It was found that their polarizability does not depart greatly from axial symmetry.

A.Tybulewicz

539.19

17800 ELECTRONIC STRUCTURE AMD HYPERFINE STRUCTURE CONSTANTS OF NO MOLECULE.

C.C.Lin, K.Hijikata and M.Sakamoto.

J. chem. Phys., Vol. 33, No. 3, 878-81 (Sept., 1960).

The coupling constants of the magnetic hyperfine, electric quadrupole, and spin-orbit interaction were calculated from the self-consistent field molecular orbitals formed by linear combination of atomic orbitals. The calculated values of the electron spin—orbit, nuclear spin—orbit, and nuclear—electronic spin—spin interaction constants agree reasonably well with experiment. The results for the nuclear quadrupole coupling constant and the Fermi contact term are less satisfactory, although the latter can be improved by configuration mixing. The relations of these coupling parameters to the electronic structure of the molecule are discussed.

539.19

17801 MO TREATMENT OF ACETYLENE INCLUDING ALL ELECTRONS. L.Burnelle.

J. chem. Phys., Vol. 32, No. 6, 1872-3 (June, 1960).

Reports a single-configuration SCFMO calculation, which confirms the qualitative conclusions of simple molecular orbital treatments, and agrees fairly well with experiment. See following abstract.

J.Hawgood

539.19

17802 CHARGE DISTRIBUTION, HYBRIDIZATION AND BONDING IN ACETYLENE AND CARBON DIOXIDE.

A.D.McLean, B.J.Ransil and R.S.Mulliken.

J. chem. Phys., Vol. 32, No. 6, 1873 (June, 1960).

Reports electron population analysis for McLean's wave-functions (Abstr. 13450 of 1960), and compares it with Burnelle's for C_2H_2 (see preceding abstract). The general agreement is good, though there are quantitative differences ascribed to Burnelle's integral approximations.

J.Hawgood

539.19

17803 A MODIFICATION OF KOOPMAN'S THEOREM FOR CONJUGATED HYDROCARBONS.

J.R.Hoyland and L.Goodman.

J. chem. Phys., Vol. 33, No. 3, 946-7 (Sept., 1960).

Within the framework of the Pariser—Parr approximation, some modifications (in the calculation of ionization potentials) in Koopman's theorem are suggested. (1) The effect of π electron ionization on the framework is considered by making Z for the σ electrons dependent upon the change in π electron density on the atoms due to ionization. This leads to a change in the σ electron energy of the order of 0.8 eV. (2) The changes following ionization in the $C2p_z$ basis functions are considered by making the electron repulsion integrals $(pp\,|\,qq)$ dependent on the change in π electron density Δq_{pq}. This leads to improvements of the order of 1 eV. Most of the remaining discrepancy in the ionization potential between theory and experiment can probably be accounted for by considering changes in the π MO's through the construction of a new Hartree—Fock Hamiltonian for the ionized state. These modifications are applied to six conjugated hydrocarbons.

T.E.Peacock

539.19

17804 PAPERS FROM THE CONFERENCE ON MOLECULAR QUANTUM MECHANICS, HELD AT THE UNIVERSITY OF COLORADO, BOULDER, COLORADO, U.S.A., JUNE 21-27, 1959. INTRODUCTORY NOTE.

R.G.Parr.

Rev. mod. Phys., Vol. 32, No. 2, 169 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The forty-three papers presented at this conference cover the whole field of molecular quantum mechanics except ligand field theory. They may be conveniently classified as follows: (1) Atoms and Small Molecules, (2) The Many Body Problem and Density Matrices, (3) Atoms in Molecules Methods, (4) Nature of the Chemical Bond, (5) Reaction Rates and Intermolecular Forces, (6) Complex Molecules and (7) Problems in Structure and Spectra.

T.E.Peacock

539.19

17805 PRESENT STATE OF MOLECULAR STRUCTURE CALCULATIONS. C.A.Coulson.

Rev. mod. Phys., Vol. 32, No. 2, 170-7 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). This paper reviews the position of Molecular Quantum Mechanics at the close of the 1950's. It is divided int three parts. The first is devoted to a discussion of the develop ments in the field since the Texas Conference at the end of 195 The second part discusses the major conclusions of the Boulder Conference. In the third part the author discusses the lines alo which he thinks Molecular Quantum Mechanics will develop in th near future.

T.E.Pea

539.19 : 539.18 : 5

17806 GROUND STATE OF SYSTEMS OF THREE PARTIC WITH COULOMB INTERACTION.

W.Kolos, C.C.J.Roothaan and R.A.Sack.

Rev. mod. Phys., Vol. 32, No. 2, 178-9 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). The wave-function describing the behaviour of t particles of comparable mass is chosen to have the form of a generalized Hylleraas type function:

$$\psi = \text{const.}\ \exp(-\alpha_{12}r_{12} - \alpha_{23}r_{23} - \alpha_{31}r_{31})P(r_{12}, r_{23}, r_{31})$$

where the α's as well as the polynomial P are allowed to vary. polynomials found to give the best results in the cases investiga have between 50 and 60 terms. The technique is applied to He, $e^+e^-e^-$, $p\mu p$, $d\mu d$ and H_2^+. The technique becomes unsatisfactory when two of the particles are much heavier than the third. In th case of H_2^+ the energy, which should correspond to the lowest vibrational level, falls nearer to the first excited level.

T.E.Pea

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17807 SELF-CONSISTENT FIELD THEORY FOR OPEN SHELLS OF ELECTRONIC SYSTEMS. C.C.J.Rooth

Rev. mod. Phys., Vol. 32, No. 2, 179-86 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). Using a similar type of formalism to that used the author in considering closed shell systems (1951), the open shell SCF problem is formulated and solved. Coulomb and exch operators for the open shells are defined. It is shown that both closed and open shell eigenvectors are solutions of the same eig value problem. This method avoids the difficulties of open-clos shell eigenvector orthogonality which arise in most treatments this problem. The theory is then extended to the LCAO approximation commonly used in molecular orbital calculations.

T.E.Pea

539.19 : 53

17808 ANALYTICAL SELF-CONSISTENT FIELD FUNCTIO FOR THE ATOMIC CONFIGURATIONS $1s^2$, $1s^22s$ AN $1s^22s^2$.

C.C.J.Roothaan, L.M.Sachs and A.W.Weiss.

Rev. mod. Phys., Vol. 32, No. 2, 186-94 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abs 13426 of 1960). Using the SCF theory developed in the previous paper (see preceding abstract), SCF solutions are calculated for the configurations of atoms with Z values from 2 to 10. The wavefunctions, orbital energies, ionization potentials and total energ are tabulated. Radial functions are also given for Li (r = 0-28 a. Be (r = 0-18 a.u.) and Li^- (r = 0-50 a.u.).

T.E.Peac

53

17809 ON THE ROLE OF THE EQUIVALENCE RESTRICTI IN MOLECULAR CALCULATIONS. A.J.Freeman.

Rev. mod. Phys., Vol. 32, No. 2, 273-4 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abs 13426 of 1960). Two formulations of the "open shell" SCF proble are discussed, (i) Roothaan's (preceding abstracts) which is an average equivalence restriction procedure and (ii) Nesbet's sche which restricts the spin orbitals to be orthonormal transforms (equivalence restriction) of sets of symmetry orbitals (symmetr restriction). Both methods are applied to OH. It is seen that the LCAO MO coefficients and orbital energies are in good agreeme The total energies and dipole moments are also in good agreeme

T.E.Peac

53

17810 CORRELATED ORBITALS FOR THE GROUND STAT OF HELIUM-LIKE SYSTEMS.

C.C.J.Roothaan and A.W.Weiss.

Rev. mod. Phys., Vol. 32, No. 2, 194-205 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abs of 1960). Wave-functions of the type

$$\Phi_C = \phi(r_1)\,\phi(r_2)\,x(r_{12})$$
$$\Phi_0 = [\phi(r_1)\ \psi(r_2) + \psi(r_1)\,\phi(r_2)]\,x(r_{12})$$

ed to calculate the solution of the two electron problem for , Li^+, Be^{2+}, C^{4+} O^{6+}, Ne^{8+}. Φ_C is a correlated closed shell unction and Φ_0 an open shell correlated wave-function and

$$\phi(r) = \sum_{i=0}^{m} a_i\, u_i(r)$$

$$\psi(r) = \sum_{i=0}^{m} b_i\, u_i(r)$$

$$x(r_{12}) = \sum_{\mu=0}^{n} c_\mu v_\mu(r_{12})$$

r $u_i(r) = (\zeta r)\,e^{-\zeta r}$ and $v_i(r_{12}) = (\zeta r_{12})^{\mu}$. $x(r_{12})$ is the correlation n and the coefficients a_i, b_i, c_μ and the orbital exponents ζ variational parameters. Using the SCF methods discussed preceding abstracts the closed shell problem converges whereas the open shell problem is found to be slowly con- t. Formulae for the Hamiltonian matrix elements including rrelation terms are given. Energies, correlation functions of pes and coefficients are tabulated for the seven atoms over range of values for Zr. The diamagnetic susceptibility for alculated in both correlation approximations. The closed pproximation gives a value of 1.876×10^{-6} and the open shell imation gives a value of 1.889×10^{-6}, both of which are in greement with the experimental value of 1.88×10^{-6}.
T.E.Peacock

539.19

311 CORRELATED ORBITALS FOR THE GROUND STATE OF THE HYDROGEN MOLECULE.

os and C.C.J.Roothaan.
nod. Phys., Vol. 32, No. 2, 205-10 (April, 1960).

Molecular Quantum Mechanics" Conference paper (see Abstr. of 1960). The wave-functions discussed in the preceding ct for two electron atoms are used to discuss the H_2 molecule. orrelation function $x(r_{12})$ is in this case taken to be a function interatomic distance. The energies and coefficients for both of correlation are given. The calculated dissociation energy 1 eV) is 0.0405 eV below the observed value. T.E.Peacock

539.19

12 CONFIGURATION INTERACTION IN THE HYDROGEN MOLECULE — THE GROUND STATE.

McLean, A.W.Weiss and M.Yoshimine.
mod. Phys., Vol. 32, No. 2, 211-18 (April, 1960).

Molecular Quantum Mechanics" Conference paper (see Abstr. of 1960). A basis of primitive symmetry orbitals con- ted from Slater type atomic functions is used for an m.o. lation on H_2. The basis orbitals are

$$\sigma_g x,\ \sigma_u x = 2^{-1/2}(x_a \pm x_b)$$
$$\pi_g 2p,\ \pi_u 2p = 2^{-1/2}(2p\pi_a \mp 2p\pi_b)$$

$= 1s$, $2s$ or $2p\sigma$. Calculations including up to twelve configura- were carried out. It was found that the following five-con- ation wave-function has an energy which is only 0.01 eV higher hat obtained from any of the twelve-configuration wave- ons

$$= c_1(\sigma_g 1s, \sigma_g 1s') + c_2(\sigma 2s, \sigma_g 2p) + c_3(\sigma_u 1s, \sigma_u 1s') + \\ + c_4(\pi_u 2p, \pi_u 2p) + c_5(\pi_g 2p, \pi_g 2p)$$

e $(\sigma_g 1s, \sigma_g 1s')$ is the basic configuration modified to the open form with $\zeta_{1s} \neq \zeta_{1s'}$. The energies of ten different many- guration wave-functions are compared. Binding energies, ζ's oefficients are tabulated for interatomic distances $R < 6$ a.u. A bibliography of most of the previous calculations is given. T.E.Peacock

539.19

813 ACCURATE ELECTRONIC WAVE FUNCTIONS FOR THE H_2 MOLECULE. W.Kolos and C.C.J.Roothaan.

mod. Phys., Vol. 32, No. 2, 219-32 (April, 1960).

Molecular Quantum Mechanics" Conference paper (see Abstr. of 1960). This calculation extends the James—Coolidge ation to 40 terms. Parameter values, energies, potential ies and expectation values of $\langle r^2\rangle$ and $\langle 3z^2-r^2\rangle$ are tabulated for 1(1)40 terms in the expansion. These values are compared with calculations using the Roothaan SCF theory in both its open and closed shell correlation forms (see preceding abstracts).
T.E.Peacock

539.19 : 539.18

17814 SELF-CONSISTENT FIELD ATOMIC AND MOLECULAR ORBITALS AND THEIR APPROXIMATIONS AS LINEAR COMBINATIONS OF SLATER-TYPE ORBITALS.

R.S.Mulliken.
Rev. mod. Phys., Vol. 32, No. 2, 232-8 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). This paper enumerates the notation which is generally used in many-electron calculations. It also discusses the approximations made in the usual SCF theories. Problems of convergence are discussed together with the desirability of using approximate SCF wave-functions as a basis for a configuration interaction calculation. T.E.Peacock

539.19

17815 STUDIES IN MOLECULAR STRUCTURE. I. SCOPE AND SUMMARY OF THE DIATOMIC MOLECULE PROGRAM.

B.J.Ransil.
Rev. mod. Phys., Vol. 32, No. 2, 239-45 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). SCF ground state single determinant wave-functions in LCAO MO approximation are calculated for most of the diatomic molecules of the first row which have a closed shell ground state. The calculations in each case were made using the equilibrium internuclear distance, utilizing inner and valence shell Slater type orbitals with three different choices of orbital exponent. The Roothaan SCF procedure is programmed to simultaneously optimize both the energy and the orbital exponents. Molecular energies, binding energies, dipole moments, orbital energies, ionization potentials, ground state atomic energies and available experimental data are tabulated for all of the molecules investigated.
T.E.Peacock

539.19

17816 STUDIES IN MOLECULAR STRUCTURE. II. LCAO-MO-SCF WAVE FUNCTIONS FOR SELECTED FIRST-ROW DIATOMIC MOLECULES.

B.J.Ransil.
Rev. mod. Phys., Vol. 32, No. 2, 245-54 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The wave-functions of the molecules whose energetics were discussed in a companion paper (preceding abstract) are tabulated. These are Li_2, Be_2, C_2, N_2, F_2, LiH, BH, NH, HF, CO, BF, LiF. The orbital exponents of the first row atoms are given. The one centre overlap integrals for all of the twelve molecules are also given. T.E.Peacock

539.19

17817 IMPROVED MOLECULAR ORBITAL WAVE FUNCTIONS AND NUCLEAR QUADRUPOLE COUPLING IN CO, N_2 AND Li_2.

J.W.Richardson.
Rev. mod. Phys., Vol. 32, No. 2, 461-5 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The electric field gradient (EFG) is calculated for CO, N_2 and Li_2 using energy optimized wave-functions. The EFG for N_2 and Li_2 are then computed using Ransil's wave-functions (preceding abstract) which are optimized for both energy and orbital exponents. The calculations using these improved wave-functions are superior to those using only energy optimized wave-functions and the improvement is interpreted as being due to effects of orbital contraction. T.E.Peacock

539.19

17818 ROLE OF COULOMB ENERGY IN THE VALENCE-BOND THEORY.

S.Fraga and R.S.Mulliken.
Rev. mod. Phys., Vol. 32, No. 2, 254-65 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Calculations of the Coulomb energy part of the binding energy in the valence bond method, using Slater atomic orbitals, with hybridization, have been made for LiH, BH, CH, NH, HF, Li_2, N_2 and F_2 and for the excited states of H_2. The Coulomb energy is much larger for $p\sigma$ and especially for s-$p\sigma$ hybrid bonds than for s bonds. Using degrees of hybridization which are believed to be actually present, the Coulomb energy amounts to 30-40% of the gross bond energy in typical cases, as compared with 1% for H_2 at its equilibrium distance in its ground state. For Li_2 the figure is 93%. T.E.Peacock

539.19

17819 SOME PROBLEMS IN THE THEORY OF HOMONUCLEAR DIATOMIC MOLECULES.

M.Kotani, Y.Mizuno, K.Kayama and E.Ishiguro.
Rev. mod. Phys., Vol. 32, No. 2, 265-71 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The energies obtained in the valence bond and molecular orbital methods making different assumptions about the valence-core interaction are compared and contrasted. The calculations are on H_2, Li_2, B_2, N_2 and O_2. The electron spin density at one of the nuclei in O_2 is explained using simple wave-functions of MO type, in which the distortion of $2\sigma_u$-type orbitals caused by exchange interaction between these $2\sigma_u$ electrons and unpaired $\pi_g{}^{\pm}$ electrons is taken into account in different ways. T.E.Peacock

539.19

17820 DIATOMIC MOLECULE PROJECT AT RIAS AND BOSTON UNIVERSITY. R.K.Nesbet.

Rev. mod. Phys., Vol. 32, No. 2, 272-3 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The scope of the programmes for molecular calculations, written for the IBM 704,is discussed. As an illustration, the results of a calculation on HF are given. The binding energy is found to be 4.409 eV. All of the integrals used were transformed to the orthonormal self consistent basis and matrix elements of the dipole moment operator were computed in a total time of forty-five minutes. Nine independent σ orbitals and five independent π orbitals including $d\sigma$ and $d\pi$ orbitals were used. T.E.Peacock

539.19

17821 BASIC FUNCTIONS FOR AB INITIO CALCULATIONS.

L.C.Allen and A.M.Karo.
Rev. mod. Phys., Vol. 32, No. 2, 275-85 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). A comprehensive table of the results of available calculations on molecules made up of atoms of the first row of the periodic table is given. In all some 74 calculations are included. The review is confined to systems containing more than two electrons. A discussion of energies, binding energies etc. with respect to a choice of basic orbitals is given, with particular reference to HF. Present ideas on the choice of basis orbitals for ab initio calculations are discussed in the final section. T.E.Peacock

539.19

17822 MATHEMATICAL PROBLEMS IN THE COMPLETE QUANTUM PREDICTIONS OF CHEMICAL PHENOMENA

S.F.Boys and G.B.Cook.
Rev. mod. Phys., Vol. 32, No. 2, 285-95 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The calculation of general many-electron wave-functions for atoms and molecules by variational determinantal expansions is classified as consisting of eight stages. It is shown that it is possible to calculate any observable electronic property by means of one or more further stages to an accuracy consistent with the Born—Oppenheimer approximation and with the omission of relativistic effects. The application of this systematization to problems of programming for electronic digital computation is discussed. T.E.Peacock

539.19

17823 CONSTRUCTION OF SOME MOLECULAR ORBITALS TO BE APPROXIMATELY INVARIANT FOR CHANGES FROM ONE MOLECULE TO ANOTHER. S.F.Boys.

Rev. mod. Phys., Vol. 32, No. 2, 296-99 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). This paper is an attempt to define orbitals which are almost insensitive to alterations in distant nuclear charges. These orbitals are localized around the chemical valency links and the atomic lone pairs. They are called "exclusive" orbitals and two theorems required in their formulation are proved in an appendix. T.E.Peacock

539.19

17824 CANONICAL CONFIGURATIONAL INTERACTION PROCEDURE. J.M.Foster and S.F.Boys.

Rev. mod. Phys., Vol. 32, No. 2, 300-2 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Starting from an energy minimized Slater determinant a set of "exclusive orbitals" are constructed which minimize the energy. Correlation is then allowed for by choosing the further criterion that they maximize the dipole moment matrix elements between the "exclusive orbitals" and some associated set which are called "oscillator orbitals". In applying the method to HCH it is seen that the centroids of the exclusive orbitals bear a rem able resemblance to the chemical picture of valence structure. T.E.Pea

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17825 A QUANTUM VARIATIONAL CALCULATION FOR H

J.M.Foster and S.F.Boys.
Rev. mod. Phys., Vol. 32, No. 2, 303-4 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). This paper reports an SCF calculation on HCHC using a basis of Slater atomic orbitals. The computer program for EDSAC 2 implement the stages in the Boys and Cook plan (s preceding abstracts). Although the SCF orbitals are spread ove all of the molecule, the transition to exclusive orbitals, which r present extreme localization, can be effected with only a small amount of time on an automatic computer. The use of other cod enables the correlation of electronic positions to be taken into account; minimizing of the energy occurs by increasing their av distance apart. The dipole moment calculated from the SCF ap mation is 1.1 D. The SCF and exclusive orbital coefficients are tabulated. T.E.Pea

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17826 QUANTUM VARIATIONAL CALCULATIONS FOR A RANGE OF CH_2 CONFIGURATIONS.

J.M.Foster and S.F.Boys.
Rev. mod. Phys., Vol. 32, No. 2, 305-7 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). This paper reports an extensive configuration interaction calculation using a basis of eight Slater-type atomic orbitals. The calculations predict that the states ${}^3B_1$, ${}^1A_1$ and ${}^1B$ in increasing energy order for both the linear and bent equilibri positions. As a guide to the extent of the configuration interacti included, 128 configurations were used in the ${}^3B_1$ case. The tota energy was found to be ${}^3B_1 = -38.904$ a.u.; ${}^1A_1 = -38.865$ and ${}^1B_1 = -38.808$ a.u. and $\angle$ HCH = 129°, 90° and 132° respectively. The force constants for all three states are tabulated. Calculati of these quantities for CH and energies of relevant C valence st have also been carried out and are given for comparison. T.E.Pea

53

17827 CALCULATIONS ON THE ELECTRONIC STRUCTU OF THE NORMAL STATE OF FORMALDEHYDE.

P.L.Goodfriend, F.W.Birss and A.B.F.Duncan.
Rev. mod. Phys., Vol. 32, No. 2, 307-11 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). The results of an LCAO-MO SCF calculation in which all sixteen electrons are included are given. The ground is represented by a single determinant corresponding to a configuration of closed electron shells. The atomic orbital basis functions used are 1s, 2s and 2p on the C and O atoms and 1s on the H atoms. These atomic functions were chosen to be Slater orbitals with fixed orbital exponents. The total electronic energ was found to be −104.705 a.u. and the total molecular energy −113.591 a.u. The dissociation energy was found to be 0.440 a.u (exptl. 0.586). As is to be expected, a one configuration approximation gives transition energies and intensities which are in poo agreement with experiment. The SCF m.o.'s, orbital energies a coefficients are tabulated. T.E.Pea

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17828 IONIZATION POTENTIAL OF AMMONIA — SOME IMPLICATIONS CONCERNING KOOPMAN'S THEOR

J.C.Lorquet.
Rev. mod. Phys., Vol. 32, No. 2, 312 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). The ground state of the NH_3^+ ion has been studi using the LCAO-SCF m.o. method, using a basis of Hartree—Fo a.o.'s. The calculations have been carried out for both the pyra and planar configurations. The ionization potential has been est mated using Koopman's theorem and also by the difference in e between the self-consistent ground state and the self-consistent ionized state. It is found that the former is much higher above observed ionization potential than the latter. In an examination data on thirteen molecules it is found that the estimated ionizat potential using Koopman's theorem is always less than the obse value when Slater a.o.'s are used as basis functions whereas it always greater than the observed value when a basis of Hartree Fock a.o.'s are used. T.E.Pea

539.19

29 LOCAL-ENERGY METHOD IN ELECTRONIC ENERGY CALCULATIONS.

rost, R.E.Kellog and E.C.Curtis.
nod. Phys., Vol. 32, No. 2, 313-17 (April, 1960).
Molecular Quantum Mechanics" Conference paper (see Abstr.
of 1960). The Schrödinger equation is written in the form
ψ/ψ. Each point in configuration space has a "local" energy
iated with it. If ψ is exact then E is a constant over all points
space. An approximate wave-function ϕ gives a local energy
ulated from $H\phi/\phi$ which is a varying function in the space.
st squares method of approximation developed by the author
years ago has been programmed for an electronic computer.
echnique is applied to hydrogen molecule ion using a mesh in
uration space of forty points. The agreement in energy values
erent points in space is very good, the maximum deviation
0.2%. T.E.Peacock

539.19 : 539.18

330 RELATIVISTIC CORRECTIONS IN MANY-ELECTRON SYSTEMS. A.Fröman.

mod. Phys., Vol. 32, No. 2, 317-21 (April, 1960).
'Molecular Quantum Mechanics" Conference paper (see Abstr.
of 1960). This paper describes an extension of the Breit
y of calculating relativistic corrections in many electron atoms
perturbation theory. A detailed analysis of the magnitude of
orrection in He using different sets of unperturbed wave-
ions is given. Hydrogen-like functions give the wrong sign for
elativistic correction. The values of the relativistic correction
e^+, He, C^{5+}, C^{4+}, Be, Al^{11+}, Al^{3+} and F^- are given. From these
ts it can be seen that the bulk of the correction is "localized"
inner closed shells, whereas this is probably not true for
elation energy. For calculations in which energy differences
aken relativistic effects will be expected to cancel out.
T.E.Peacock

539.19

7831 STATISTICAL THEORY OF ELECTRONIC ENERGIES. S.Golden.

mod. Phys., Vol. 32, No. 2, 322-7 (April, 1960).
"Molecular Quantum Mechanics" Conference paper (see Abstr.
6 of 1960). This paper shows that with modifications the
nas—Fermi theory can give electronic energies which approach
of quantum mechanical calculations. When the problem is
rmulated in a density matrix formulation, it reduces to one of
rmining good approximations to an exponential function of the
iltonian. When this is approximated by a form which commutes
kinetic and potential energies, the original Thomas—Fermi
ry results. An improvement occurs if one uses

$$e^{zH} = e^{zV} x(z) e^{zH_0}$$

e V and H_0 are the potential and kinetic energies respectively
x(z) has the form

$$x(z) = \sum_{k=0}^{\infty} z^k Q_k . R_k$$

e Q_k is a function of space coordinates only and R_k of momentum
dinates. The problem reduces to finding a good approximation
. This problem is being investigated using density matrix
ods, and is being applied to H_2^+. A preliminary value of the
ing energy for the ground state of H_2^+ is 0.085 a.u., while an
librium distance of 2.1 a.u. is given in a footnote.
T.E.Peacock

539.19 : 539.18

7832 EXPANSION THEOREMS FOR THE TOTAL WAVE FUNCTION AND EXTENDED HARTREE—FOCK IEMES. P.O.Löwdin.

mod. Phys., Vol. 32, No. 2, 328-34 (April, 1960).
"Molecular Quantum Mechanics" Conference paper (see Abstr.
26 of 1960). The convergence of sets of basis functions in many
ctron theories is considered. The representation of the total
e-function in terms of a basis of natural spin orbitals (which
gonalize the one-particle density matrix) is considered. The
oduction of a correlation factor $g = g(r_{12}, r_{13}, r_{23} \ldots)$ is considered,
the effect on the natural spin orbitals due to this is considered.
use of projection operators to factorize a secular determinant
alternatively to split the set of basis functions is then considered.
next section deals with the problem of introducing correlation
the Hartree—Fock scheme where the expansion is truncated to a single determinant. The use of "split" orbitals is discussed and the construction of the appropriate projection operator to separate out the singlet state discussed. An alternative approach is to use a many electron correlation factor of the type discussed above. Finally the use of both methods together is considered. The three methods are compared in a calculation on He. T.E.Peacock

539.19 : 539.18

17833 SOME RECENT ADVANCES IN DENSITY MATRIX THEORY. R.McWeeny.

Rev. mod. Phys., Vol. 32, No. 2, 335-69 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). A comprehensive review of the developments in density matrix theory is given. In the first section its use in thermodynamics and statistical mechanics and its historical development is discussed. In the next section its use in the quantum mechanics of N-electron systems is fully discussed. This is largely a review of the author's work together with that of P.O.Löwdin. Problems arising from the introduction of correlation, configuration interaction and Hartree—Fock schemes into N-electron problems are discussed, together with their formulation in terms of density matrices. In the final section, a density matrix theory of open shell configurations and the use of generalized product functions are developed. T.E.Peacock

539.19

17834 GENERAL ANALYSIS OF VARIOUS METHODS OF ATOMS IN MOLECULES. T.Arai.

Rev. mod. Phys., Vol. 32, No. 2, 370-400 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Reviews the development of the "atoms in molecules" theory from its original formulation by Moffitt to its present state. The author then uses certain corrected atomic wave-functions to construct the molecular wave-function in an atoms-in-molecules scheme. These atomic functions contain a parameter ρ, a correction function which takes into account the deformation of the charge cloud of the atom in its molecular environment. In calculating the energy matrix a series of terms arises in which the first is dominant. If more terms are considered the energy matrix factorizes into inter and intra atomic energies. The energy loss of atoms in molecules due to the deformation ρ is obtained from the second and third terms of the expansion. Their values depend on the choice of ρ. T.E.Peacock

539.19

17835 ELECTRONIC STRUCTURE AND BINDING ENERGY OF CARBON MONOXIDE. A.C.Hurley.

Rev. mod. Phys., Vol. 32, No. 2, 400-11 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Two theoretical calculations of the binding energy and ground state wave-function of CO are described. The first is an ab initio calculation and the second employs the intra-atomic correlation correction (ICC) introduced by Hurley as a necessary modification to Moffitt's atoms in molecules method. The orbital calculation is carried out in such a way as to facilitate the transition to the ICC theory by means of a transformation matrix T. The basis functions of the orbital calculations are Slater type atomic orbitals with fixed exponents. A set of valence bond basis functions were then obtained from an expansion of the self-consistent field molecular orbital function. 23, 39 and 48 terms in the orthogonalized valence bond basis are used giving total energies of −112.437, -112.438_4 and −112.438 a.u. and binding energies of 7.45, 7.50 and 7.50 eV respectively. The ICC calculation (including 23 terms) gives a total energy of −113.377 a.u. and a binding energy > 11.00 eV. The dipole moment in the orbital calculation is found to be 1.00 D and in the ICC calculation −0.37 D. The experimental value is 0.12 D.
T.E.Peacock

539.19

17836 SOME RECENT RESULTS CONCERNING THE ELECTRONIC DENSITY AND THE FORCE CONSTANTS OF SMALL MOLECULES.

S.Bratož, R.Daudel, M.Roux and M.Allavena.
Rev. mod. Phys., Vol. 32, No. 2, 412-17 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). A chemical bond has been characterized by the quantity $\delta(R)$

$$\delta(R) = \rho(R) - \rho^F(R)$$

where $\rho(R)$ is the electronic density at a point R and that which would result if two atoms making up the molecule could be added

together without perturbing each other. δ(R) is a measure of the distortion of the atomic electronic clouds subsequent to the bond formation. A positive δ(R) signifies an accumulation of electrons, a negative δ(R) a deficiency. This function is evaluated for H_2, N_2 and O_2, good wave-functions being available in all cases. The results obtained agree qualitatively with what one expects from chemical intuition. The second part of the paper is devoted to the calculation of force constants. The force constants of some mono and diatomic hydrides are calculated using a modified united atoms approach.
T.E.Peacock

539.19

17837 QUANTUM MECHANICAL CALCULATIONS OF SHORT-RANGE INTERMOLECULAR FORCES.

J.T.Vanderslice and E.A.Mason.

Rev. mod. Phys., Vol. 32, No. 2, 417-21 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Very approximate expressions for the potential energy of a molecule are written down according to a modified perfect pairing procedure. This leads to a series of equations which consist purely of exchange terms, Coulomb terms being ignored. The exchange terms can then be eliminated leading to a relationship between the various potential energies. In diatomics of first row elements, knowledge of two potential energy curves enables one to calculate all of the curves leading to the ground state. The whole scheme is semiempirical in nature and can only be justified by appeal to experiment. The theory is applied to N—N, O—O and N—O systems. The results are in good agreement with experiment.
T.E.Peacock

539.19

17838 FORCE CURVES FOR EXCITED ELECTRONIC STATES.

W.L.Clinton and W.C.Hamilton.

Rev. mod. Phys., Vol. 32, No. 2, 422-4 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The Jahn—Teller effect has recently been discussed by Clinton and Rice (Abstr. 6205 of 1959) from the point of view of electrostatic forces. Some simple formulae were derived for calculating intramolecular forces in excited and ionized molecular states using molecular orbital theory. In this paper these formulae are used to calculate force curves for O_2^+ and NO both in the ground and excited states. In the final section these calculations are extended to electronic states which differ only in spin or orbital angular momentum. The method is illustrated with calculations on some of the low-lying states of O_2.
T.E.Peacock

539.19

17839 BOND ALTERNATION IN LONG POLYENES.

M.Tsuji, S.Huzinaga and T.Hasino.

Rev. mod. Phys., Vol. 32, No. 2, 425-7 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Using Huckel molecular orbital theory, it is shown that in conjugated polyenes there is bond alternation. This persists when the chain is infinite in length. In this case the bond lengths are 1.40 and 1.36 A.
T.E.Peacock

539.19

17840 SOME ELECTRONIC ASPECTS OF BIOCHEMISTRY.

B.Pullman and A.Pullman.

Rev. mod. Phys., Vol. 32, No. 2, 428-36 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). Reviews the extensive progress made by the authors' group in Paris in recent years. Discussion is confined to two topics (1) Energy transfer in biological systems and mechanisms of action of oxido-reduction enzymes. (2) Electronic structure and cancer chemotherapy. Results are given for m.o. calculations on many biologically important large heterocyclics, e.g. purines and large molecules such as DPN and ATP.
T.E.Peacock

539.19

17841 SEMIEMPIRICAL THEORY OF VIBRONIC INTERACTIONS IN SOME SIMPLE CONJUGATED HYDROCARBONS.

A.D.Liehr.

Rev. mod. Phys., Vol. 32, No. 2, 436-9 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abstr. 13426 of 1960). The charge non-uniformities in a homocyclic molecule which arise during the movement of nuclei in vibrations are considered. These are shown to occur only if certain cross terms are non-vanishing. The application of this to the calculation of vibronic intensities in electronically forbidden bands is discussed. Using the well-known Lennard-Jones approximation for the variation of the aromatic resonance integral β with nuclear displacement author has estimated the value of the constants k_1 and k_2 which particularize the Jahn—Teller effect in $C_6H_6^+$ and computed vibronically allowed intensities in benzene-like systems. Two possible electronic energy surfaces for $C_6H_6^+$ in which $k_2 = 0$ an $k_2 \neq 0$ are drawn.
T.E.Pe

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17842 ANALYSIS OF ROTATORY DISPERSION CURVES.

A.Moscowitz.

Rev. mod. Phys., Vol. 32, No. 2, 440-3 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). The rotational strength R_{ba} for a transition fro orbital a to b is given by

$$R_{ba} = |m\{(a|u_e|b) . (b|u_m|a)\}$$

where u_e and u_m are the electric and magnetic dipole operators respectively exclusive of spin. This quantity can be obtained fr the observed dichroism curve. The sum of contributions from other transitions is allowed for by a correction term which cont three coefficients to be determined from empirical data. The method has been applied to twenty-eight ketones. The agreemen with experiment is excellent in the three examples quoted in the
T.E.Pea

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17843 THEORY OF THE OPTICAL ACTIVITY OF BIMESI DERIVATIVES.

E.Wasserman.

Rev. mod. Phys., Vol. 32, No. 2, 443-4 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). The rotational strength of a molecule is related its optical activity through the Rosenfeld equation

$$\text{Opt. act./molecule} \propto \sum_k \left|\nu^2 R_k\right| \nu_k^2 R_k \; (\nu_k^2 - \nu^2)$$

where R_k is the rotational strength of the k-th transition, ν_k is excitation energy of the k-th transition and ν is the frequency of light employed. The optical activity of nine 3,3' disubstituted bimesityls are calculated using this formula and are shown to be fair agreement with experiment.
T.E.Pea

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17844 ENERGY LEVELS OF F_2 AND F_2^+.

K.Hijikata.

Rev. mod. Phys., Vol. 32, No. 2, 445-6 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abs 13426 of 1960). ASMO calculations on F_2 and F_2^+ with configurat interaction are reported. No excited states involving excitation the 1s shells are included. Eight configurations which interact the ground are included. The results are shown to be superior t atoms-in-molecules calculation. The first few excited states of are calculated at two interatomic distances. The energies of the lowest excited states of F_2^+ all lie in the Rydberg region of the spectrum.
T.E.Pea

53

17845 TIME-DEPENDENT MEASUREMENTS AND MOLEC STRUCTURE: OZONE.

R.S.Berry.

Rev. mod. Phys., Vol. 32, No. 2, 447-54 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Abs 13426 of 1960). A general discussion of the quantum mechanical tunnelling in molecules undergoing vibrations is given. The ozo molecule is chosen for illustration. There are an infinite numbe possible large amplitude motions which could lead to tunnelling the most favourable is found by examining the full potential surf separating the initial configuration from the final one, which diff from it by a cyclic permutation of the nuclei. The saddle of the potential energy surface between these points is then found. In the potential barrier is found to be of the order of 148 kcal/mole A final section discusses the methods by which tunnelling in ozo may be observed.
T.E.Peac

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17846 WEAK INTERACTIONS IN MOLECULAR QUANTUM MECHANICS.

M.Karplus.

Rev. mod. Phys., Vol. 32, No. 2, 455-60 (April, 1960).

"Molecular Quantum Mechanics" Conference paper (see Ab 13426 of 1960). Using approximate electronic wave-functions a theory is given for calculating weak interactions using perturba theory. There are two methods for doing this. (1) The average ution energy approach and (2) the differential equation approach. of these methods reduce the problem of evaluating the second d perturbation energy ΔE_0^2 to one involving only the ground state -function Ψ_0^0. The second order as well as the first order rbation energy is expressed in a form which does not require wledge of zero order energies and the further problems iated with the importance of the continuum contribution. The y is applied to calculating the molecular susceptibility and n magnetic shielding in H_2. Some preliminary results are for a similar study on H_2O and NH_3. T.E.Peacock

539.19

847 METALLIC REFLECTION FOR MOLECULAR CRYSTALS. B.G.Anex and W.T.Simpson.

mod. Phys., Vol. 32, No. 2, 466-76 (April, 1960).

Molecular Quantum Mechanics" Conference paper (see Abstr. of 1960). The reflectance of light in certain molecular crystals estuffs is similar to that observed in metals. The reflectance rum of the crystal is interpreted according to classical disper-heory modified to contain quantum oscillator strengths. A um mechanical interpretation using perturbation theory is then . The method is essentially that of calculating electrostatic rbations for weakly interacting molecules. In addition to mb interaction the field radiated by the acceleration occurring individual molecules is considered. T.E.Peacock

539.19

848 ON THE EXISTENCE OF POLYOXIDES OF HYDROGEN. S.W.Benson.

em. Phys., Vol. 33, No. 1, 306-7 (July, 1960).

Thermochemical argument, based on the law of additivity of enthalpies, suggests that H_2O_4 cannot exist while H_2O_3 might at low temperatures. W.Good

539.19

849 DIPOLE MOMENT OF ISOTACTIC AND ATACTIC POLY-VINYL ISO-BUTYL ETHER.

keda, Y.Imamura, S.Okamura and T.Higashimura.

em. Phys., Vol. 33, No. 2, 631-2 (Aug., 1960).

Mean dipole moments per monomer unit are determined for type of polymer in benzene solution at 25° and 50°C. The ent for the isotactic polymer is 10% larger than that for the ic one, and this may be explained if the former takes more al conformation than the latter. J.Sheridan

539.19

850 DIPOLE MOMENT AND CONFORMATION OF 2-CHLOROCYCLOHEXANE.

roslavsky and E.D.Bergmann.

em. Phys., Vol. 33, No. 2, 635 (Aug., 1960).

The dipole moment was determined in benzene solution at C and 52.0°C, and compared with the theoretical values for the torial and axial conformations of the solute molecule. The ulated amount of equatorial conformation decreases as the perature is raised, from 61% at 27.4°C to 41% at 52°C, and this is accordingly the more stable one under these conditions. troscopic data can be explained on this basis. J.Sheridan

539.19

7851 EXPLANATION OF THE NONADDITIVITY OF BOND LENGTHS. H.A.Bent.

em. Phys., Vol. 33, No. 1, 304-5 (July, 1960).

An attempt is made to explain why the CF bond length in CF_4 ss than that in CH_3F and why the bond length in both cases is than that obtained from simple additivity. The reasons are ght to be due to differences in electronegativities together with changes in hybridization. R.A.Ballinger

539.19

7852 BOND-ORDER/BOND-LENGTH AND BOND-ENERGY/BOND-LENGTH RELATIONS FOR CARBON—OXYGEN NDS. F.L.Pilar.

olecular Spectrosc., Vol. 5, No. 1, 72-7 (July, 1960).

A bond-order/bond-length relation based on molecular orbital ry is proposed and compared with a bond-energy/bond-length tion based on thermochemical calculations. A reinterpretation he electronic structure of furan based on the bond-order/bond-th/bond-energy relations is suggested and discussed.

539.19

17853 SPECTROSCOPIC CONSTANTS OF MOLECULES. VII. RELATION BETWEEN FORCE CONSTANT AND EQUILIBRIUM INTERNUCLEAR DISTANCE FOR HYDRIDE DIATOMS. Y.P.Varshni, S.S.Mitra and R.C.Shukla.

Indian J. Phys., Vol. 33, No. 11, 473-82 (Nov., 1959).

For Pt VI see Abstr. 5895 of 1960. For hydride diatoms, a relation between the force constant k_e and equilibrium internuclear distance r_e has been suggested : $k_e r_e^4 = C$, where C is a constant depending on the type of the linkage. The validity of the relation for ground and excited states of various hydride diatoms has been examined.

539.19

17854 MOLECULAR STRUCTURE OF LITHIUM CHLORIDE DIMER. THERMODYNAMIC FUNCTIONS OF Li_2X_2 (X = Cl, Br, I). S.H.Bauer, T.Ino and R.F.Porter.

J. chem. Phys., Vol. 33, No. 3, 685-91 (Sept., 1960).

A previously described electron diffraction apparatus [Hastings and Bauer, J. chem. Phys., Vol. 18, 13 (1950)] has been suitably modified for the study of vapours at high temperatures. A furnace and auxiliary power supply have been constructed, and a serviceable design for a sample container, with a nozzle, has been developed. Data on two systems have been obtained. The diffraction pattern produced by caesium chloride vapour is that expected for a diatomic molecule; the interatomic distance determined in this experiment checks with the microwave value. In lithium chloride vapour, dimers predominate. Their structure is diamond shape (planar) with Li—Cl = 2.23 ± 0.03 A, Cl—Cl = 3.61 ± 0.03 A, ∠ClLiCl = 108° ± 4°. The dimensions of the lithium halide dimers are compared and their thermodynamic functions tabulated.

539.19

17855 AN ELECTRON DIFFRACTION INVESTIGATION OF THE STRUCTURE OF THE PHOSPHORUS PENTOXIDE MOLECULE. P.A.Akishin, N.G.Rambidi and E.Z.Zasorin.

Kristallografiya, Vol. 4, No. 3, 360-4 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 334-8 (March, 1960).

An investigation by electron diffraction of gaseous phosphorus pentoxide. The evaporation was in a molybdenum ampoule at a temperature which gave a vapour pressure of 5-10 mm Hg in the ampoule. The electron diffraction photographs were measured on a microphotometer. The parameters for P_4O_{10} obtained by Hampson and Stosick (Abstr. 3888 of 1938) were confirmed and refined to give the values: $r_{3,6}(P-O) = 1.60 \pm 0.01$ A; $r_{3,5}(P-O) = 1.40 \pm 0.03$ A; angle POP = 124°30' ± 1'. J.Iball

539.19

17856 ON THE EQUILIBRIUM C—H DISTANCE IN METHANE. D.P.Stevenson and J.A.Ibers.

J. chem. Phys., Vol. 33, No. 3, 762-3 (Sept., 1960).

An equilibrium C—H distance r_e of 1.091 ± 0.002 A was calculated with the aid of a normal coordinate treatment from vibrational and rotational spectroscopic data on CH_4 and CD_4. From these results the mean C—H distance, of interest in electron diffraction studies, was derived as 1.102 ± 0.002 A.

539.19

17857 INTERNAL ROTATION IN POLYMER CHAINS AND THEIR PHYSICAL PROPERTIES. XV. THE EFFECT OF INTERNAL AND INTERMOLECULAR INTERACTIONS ON EXTENSION OF POLYMERS.

M.V.Vol'kenshtein and O.B.Ptitsy̆n.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 259-64 (1959). In Russian.

For Pt XIV, see Fiz. tverdogo Tela, Vol. 1, 923 (1959).

Extends James and Guth's theory (Abstr. 257 of 1944; 2037 of 1950) by allowance for the effect of internal molecular and intermolecular interactions and compares the theory with published results for polyethylene. A.Tybulewicz

539.19

17858 MEAN SQUARE LENGTH OF A HINDERED ALKANE CHAIN. R.P.Smith.

J. chem. Phys., Vol. 33, No. 3, 876-8 (Sept., 1960).

An exact formula, valid for any number of links and any constant angle between links, is derived for the mean square end—end length of a chain, subject to the following conditions. Any three successive bonds must be in a trans configuration or one of two gauche configurations. The energy of a trans configuration is lower by E (per mole) than the energy of a gauche configuration. The excluded volume problem is ignored.

539.19

17859 ELECTRON INTERACTION IN VERY LONG LINEAR CONJUGATED MOLECULES. I. ONE-DIMENSIONAL COLLECTIVE OSCILLATION OF π ELECTRON.

Y.Mizuno and T.Izuyama.

Progr. theor. Phys., Vol. 21, No. 4, 593-605 (April, 1959).

Low-lying electronic states of very long linear conjugated molecules with equal C—C bond lengths is studied within the framework of Pariser and Parr's π electron approximation, by means of Tomonaga's one-dimensional sound wave method. It is found that as the number N of carbon atoms increases the frequency of the sound wave with the lowest wave number tends to zero in proportion to $\sqrt{\log N}/N$. It is shown that Araki and Murai's treatment, which gives a result contradicting this, contains a difficulty.

539.19

17860 QUANTUM MECHANICAL (PHASE SHIFT) ANALYSIS OF DIFFERENTIAL ELASTIC SCATTERING OF MOLECULAR BEAMS.

R.B.Bernstein.

J. chem. Phys., Vol. 33, No. 3, 795-804 (Sept., 1960).

For a spherically symmetrical intermolecular potential $V(r) = \epsilon f(r/\sigma)$ the quantum calculation of the elastic scattering cross-section $d\sigma(\theta)/d\Omega$ in the c.m. system is carried out as follows. For a given relative velocity (or de Broglie wavelength) and an assumed V(r), the radial wave equation is integrated for successive values of the angular momentum quantum number l, yielding the the phase shifts η_l. Then $d\sigma(\theta)d\Omega$ is computed in terms of the series of η_l's in the standard way. A general computational programme (following that of K.Smith) is outlined for the evaluation of the radial wave-function and the phase shifts, utilizing and IBM 704 computer. Calculations are presented for the Lennard-Jones (12,6) potential function. The results may be concisely represented using the framework provided by the semiclassical treatment of Ford and Wheeler, i.e., in terms of a set of reduced phase constants versus reduced angular momenta at various reduced relative kinetic energies K. Tables and graphs are presented from which the phases may be obtained, to a good approximation, for any given ϵ, σ and K. Computation of the differential and total cross-sections from the phase shifts is then readily accomplished. The results are compared with the classical and semiclassical treatments. The problem of tunnelling and orbiting is discussed.

539.19

17861 RESONANCES IN SUCCESSIVE OSCILLATORY FIELDS.

N.F.Ramsey.

J. Phys. Radium, Vol. 19, No. 11, 809-15 (Nov., 1958). In French.

Magnetic Resonance Symposium (see Abstr. 4804 of 1959). A general method for calculating the shapes of resonances under different circumstances is described. Although the technique used can be applied to resonance experiments in general, the applicat
are to molecular beam magnetic resonances. With this method,
velocity distribution, the strength of the uniform magnetic field,
and the amplitudes and phases of the oscillatory field may vary
arbitrarily along the molecular path; as many as nine frequencie
perturbing any combination of three energy levels may be prese
simultaneously. Results are presented showing the shapes and
distortions of the observed resonance under various conditions.
Results are described for 2, 3, 4 and infinitely many successive
oscillatory fields. The resonance shape has been calculated whe
there is a storage box between the two oscillatory fields from wh
the atoms emerge only randomly. The effects of gradual applica
of the oscillatory field have been calculated as well as the effect
different amplitudes of the two oscillatory fields of the separate
oscillatory field method. The effects of two different but nearly
equal successive frequencies in distorting the resonances are sh
both theoretically and experimentally. The presence of a third
energy level can distort the resonance under some circumstance
Finally, effects of non-uniform magnetic fields and of phase vari
tions of the oscillatory field are shown.

53

17862 MOLECULAR PROCESSES INDUCED BY μ^- MESON IN HYDROGEN BUBBLE CHAMBER. I.

M.Shimizu, Y.Mizuno and T.Izuyama.

Progr. theor. Phys., Vol. 20, No. 5, 779-9 (Nov., 1958).

The reaction time for the transfer of a μ^- meson from a pro
to a deuteron in μ^--mesic-proton collisions with deuterons at lo
energies is calculated, using a variational method. The result is
compared with the widely scattered results of other calculations
which use different approximations. E.J.Squ

53

17863 MOLECULAR PROCESSES INDUCED BY μ^- MESON HYDROGEN BUBBLE CHAMBER. II.

Y.Mizuno, T.Izuyama and M.Shimizu.

Progr. theor. Phys., Vol. 21, No. 3, 479-80 (March, 1959).

Reaction rates are calculated for μ-mesic molecular ion formation. R.J.N.Phil

539.19 : 53

K-LL SPECTRA OF NITROGEN, OXYGEN AND METHANE.
See Abstr. 17715

SOLID-STATE PHYSICS

539.2

4

CONFERENCE ON SOLID STATE PHYSICS.

Austral. J. Phys., Vol. 13, No. 2A, 209-459 (July, 1960).

he conference was held in Melbourne in August. 1959 under
spices of the Australian Branch of the Institute of Physics.
ers were read and discussed at the conference, the topics
g over a wide field. Abstracts of some of the papers will be
in this or succeeding issues of Physics Abstracts. For brief
aries and notes on all papers presented, see Abstr. 6002 of

539.2

65

ON THE ORIENTATION DEPENDENCE OF SURFACE FREE ENERGY. N.A.Gjostein.

metallurgica, Vol. 7, No. 12, 812-14 (Dec., 1959).

hen a crystal surface breaks up into a hill-and-valley struc-
onsisting of a low index plane and an irrational continuation
e, a minimum value for the orientation derivative of the
ce energy of the low index plane can be evaluated. Numerical
s are given for the (100) and (111) planes of silver heated in
nd for copper. H.Mykura

539.2

366

ON THE PROBLEM OF THE EQUATION OF STATE OF SOLIDS UNDER ULTRA-HIGH PRESSURES.

. Ryabinin.

Metallov i Metallovedenie, Vol. 9, No. 2, 312-13 (Feb., 1960).

ssian.

n empirical formula $(p + \pi)V^n = (p_1 + \pi)V_1^n$, describing the
onship between the volume, V, of a metal and pressure, p, was
in earlier work (Fiz. Metallov i Metallovedenie, Vol. 5, No. 2, 225,
to calculate V of several metals for $p \leq 5 \times 10^6$ kg/cm^2.
arison of the data calculated for Cu with the experimental
ts obtained by Walsh et al. (Abstr. 6744 of 1958) confirmed
alidity of the above formula at ultra-high pressures.

M.H.Sloboda

539.2

867

THE EQUATION FOR DEBYE CRYSTALS.

N.J.Ionescu-Pallas.

Cercetari Fiz., Vol. 10, No. 1, 75-7 (1959).

umanian.

t is shown that Debye crystals satisfy the general equation

$$\left(p + T\int_T^\infty \frac{\partial E}{\partial V}\frac{dT}{T^2}\right)(V - b) = RT$$

the same as gases and liquids. This equation, rewritten in an
alent form, as

$$p\left(V - T\int_T^\infty \frac{\partial H}{\partial p}\frac{dT}{T^2}\right) = RT$$

ins valid even in the more general cases than those where a
iction is imposed on the relation between θ and V.

539.2

7868

QUANTUM MECHANICAL LAW OF CORRESPONDING STATES FOR VAN DER WAALS SOLIDS AT 0°K.

rnardes.

. Rev., Vol. 120, No. 3, 807-13 (Nov. 1, 1960).

A quantum mechanical variational treatment based on a simple
er—London wave-function is used to describe the various
erties of Van der Waals solids at 0°K. The effects of nuclear
on on the cohesive energy, volume, compressibility, sound velo-
etc., are discussed. These effects can be expressed in the form
power series in $\hbar$, of which the first term, linear in $\hbar$, is shown
icitly. The results are in good agreement with the available
rimental data for all solidified inert gases, except for He to which
present method is not applicable.

539.2

7869

THE THEORY OF CRYSTALS OF THE NOBLE GASES.

A.V.Stepanov.

tallografiya, Vol. 3, No. 3, 392-4 (1958). In Russian. English
slation in: Soviet Physics—Crystallography (New York),
3, No. 3, 395-7 (May-June, 1958).

Experimental values for various inert gas crystal properties are compared with values determined from gas data using elementary crystal theory. Empirical relations connecting the molecular dissociation energy with the melting, boiling and critical temperatures are also given and are claimed to have wider application than the inert gas solids.

J.W.Leech

539.2

17870

AXIAL CRYSTAL FIELDS IN THE IONIC MODEL.

T.S.Piper and R.L Carlin.

J. chem. Phys., Vol. 33, No. 4, 1208-11 (Oct., 1960).

Expressions for the axial components of crystal fields of tetragonal, trigonal, and cylindrical symmetry are developed in terms of the parameters Ds and Dt. These parameters are calculated in the ionic model using Hartree--Fock 3d radial wave-functions. The calculated parameters are compared to experimental values obtained from the spectra of V (III) in Al_2O_3 and Co (II) in CoO. Tentative assignments of the bands in the spectrum of $(C_5H_5)_2Ni$ are made.

539.2

17871

DISPERSION RELATIONS FOR BLOCH FUNCTIONS.

P.E.Kaus and W.K.R.Watson.

Phys. Rev., Vol. 120, No. 1, 44-8 (Oct. 1, 1960).

It is shown that the Floquet factor $e^{ik(E)a}$ is analytic in the upper half complex energy plane, thus enabling a set of four dispersion relations to be derived from this expression as a direct result of the application of Cauchy's theorem. These relations are characterized by their ability to relate the wave number k at one energy to the wave number at all others. In particular, the imaginary part of the wave number k_i in the forbidden gap may be equated to an integral of a function of the real part of the wave number k_r over allowed energies. As an application of these dispersion relations a theorem regarding the location of the branch points has been established.

539.2

17872

A GROUP THEORETICAL PROOF OF KRAMERS' THEOREM. P.H.E.Meijer.

Physica, Vol. 26, No. 1, 61-5 (Jan., 1960).

The degeneracy of the energy levels of an ion in a crystalline field is at least two-fold if the ion contains an odd number of electrons (Kramers' theorem). This theorem can be proved entirely on the basis of group theory. It is shown that odd-electron systems have representations of the second kind. From this follows not only Kramers' theorem, but also a number of implications usually attributed to time reversal.

539.2

17873

THE SYMMETRY OF WAVE-FUNCTIONS IN HEXAGONAL CLOSE-PACKED CRYSTALS.

J.Erdmann.

Z. Naturforsch., Vol. 15a, No. 5-6, 524-31 (May-June, 1960).

In German.

The determinants which arise using the tight-binding approximation can be factorized in certain circumstances. Known group-theoretical methods are here used to achieve this factorization and applied to the special case of the hexagonal close-packed lattice.

J.W.Leech

539.2

17874

THE THEORY OF METALLIC SILVER.

P.Gombás.

Z. Naturforsch., Vol. 15a, No. 5-6, 531-5 (May-June, 1960).

In German.

The author applies methods previously developed by him to the case of metallic silver. The lattice constant, lattice energy, sublimation energy and compressibility as well as pressure—volume and pressure—compressibility relations at absolute zero are all determined. Good overall agreement with experimental values is claimed, particularly since no empirical or semiempirical parameters are introduced. It is emphasized that with the noble metals an essential part is played by the repulsive interactions between neighbouring ions and that this is in contrast to the alkali metal case.

J.W.Leech

539.2 : 530.16

IRREVERSIBLE PROCESSES IN SOLIDS. See Abstr. 16649

Lattice Dynamics

539.2

17875 THE THEORY OF VIBRATIONS OF LATTICES WITH DEFORMABLE IONS APPLIED TO THE PHYSICAL PROPERTIES OF BINARY CUBIC CRYSTALS. K.B.Tolpygo.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 211-27 (1959). In Russian.

The general theory of lattice vibrations, which allows for deformations of ions, developed earlier by the author, is applied to 25 crystals of the NaCl and CsCl types. The best agreement with experiment was obtained for alkali-halide crystals of the NaCl type. The agreement was poorer for caesium and silver halides and very poor for Mg, Ca, Sr oxides and thallium halides. This is because the assumption of purely ionic nature of binding is hardly justified for the latter two groups of crystals. Modifications of the theory (allowance for non-central forces, exchange and Van der Waals interactions; assumption that ionic charges are not integral multiples of the electronic charge) failed to produce good agreement with experiment. A.Tybulewicz

539.2

17876 STATISTICAL DYNAMICS OF SIMPLE CUBIC LATTICES. MODEL FOR THE STUDY OF BROWNIAN MOTION. R.J.Rubin.
J. math. Phys. (New York), Vol. 1, No. 4, 309-18 (July-Aug., 1960).

The system considered is an n-dimensional cubic crystal with nearest-neighbour central and noncentral harmonic forces in which the mass M of one of the lattice particles is relatively large. It is assumed that the velocities and positions of the light particles in the system (mass m) are normally distributed, at time t = 0, as in thermal equilibrium. The conditional velocity distribution for the heavy particle at time t is then a normal distribution with a time-dependent mean value. This mean value is the velocity autocorrelation function. The dispersion of the distribution is shown to be a simple function of the autocorrelation. In the limit $M/m \gg 1$ in the one- and two-dimensional lattices, the autocorrelation function is, respectively, a damped exponential and a damped oscillating exponential. These different types of statistical behaviour are related to the different dynamic properties of the medium with which the heavy particle interacts.

539.2

17877 THE WAVE SURFACES FOR ELASTIC WAVES IN CRYSTALS. K.S.Aleksandrov.
Kristallografiya, Vol. 3, No. 5, 620-3 (1958). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 3, No. 5, 627-9 (Dec., 1959).

The theoretical conclusion of Musgrave (Abstr. 800-1 of 1955; and 7211 of 1956) that there are directions in cubic and hexagonal crystals in which five elastic waves of differing velocities can be propagated has been confirmed experimentally for KBr crystals using 1.7 Mc/s ultrasonic radiation. L.Mackinnon

539.2

17878 INFRARED EIGEN FREQUENCY AND DEBYE Θ OF IONIC CRYSTALS. S.S.Mitra and S.K.Joshi.
Physica, Vol. 26, No. 4, 284-8 (April, 1960).

Using a simplified Born—Mayer potential,

$$u = -\frac{\alpha e^2 z^2}{r} + Mb\, e^{-\sigma(r/r_0)},$$

an expression for the lattice frequency of ionic crystals in terms of cohesive energy, E is obtained:

$$\nu = \frac{1}{2\pi}\left(\frac{E}{r_0{}^2 N M\mu}\right)^{1/2}\left[\frac{2\sigma(\sigma-2)}{(\sigma-1)}\right]^{1/2}$$

A relation, very similar to one given by Blackman from lattice theory of specific heat, connecting the Debye characteristic temperature Θ and the compressibility χ is also derived:

(1) for NaCl type crystals $\Theta = \frac{h}{k}\frac{1}{2\pi}\left(\frac{6r_0}{\chi\mu}\right)^{1/2}$

(2) for CsCl type crystals $\Theta = \frac{h}{k}\frac{1}{2\pi}\left(\frac{3.465\, r_0}{\chi\mu}\right)^{1/2}$

539.2

17879 LATTICE VIBRATIONS IN CRYSTALS WITH THE WURTZITE STRUCTURE.I. LIMITING VIBRATIONS IGNORING COULOMB FORCES. L.Merten.
Z. Naturforsch., Vol. 15a, No. 5-6, 512-23 (May-June); Corrige No. 7, 650 (July, 1960). In German.

The vibrational motion in the long wavelength limit ($\lambda \rightarrow \infty$) is considered. Only 6 of the 9 optical modes are found to be independent and the polarization is found to be independent of the direction of propagation. Three of the 9 modes are associated dipole moments and are thus infrared active. J.W.L

5

17880 LATTICE VIBRATIONS IN CRYSTALS WITH THE WURTZITE STRUCTURE. II. EFFECT OF COULO FORCES ON THE LIMITING VIBRATIONS. L.Merten.
Z. Naturforsch., Vol. 15a, No. 7, 626-33 (July, 1960). In Germ

The i.r. inactive optical modes are found to be altered only frequency when account is taken of the Coulomb forces. Of the three remaining dipole associated modes two are found to have frequencies dependent upon direction of propagation and polariz which are neither purely transverse not purely longitudinal exce in certain special cases. The third dipole associated mode is directionally independent in frequency and is strictly transverse J.W.L

5

17881 EQUILIBRIUM CONDITIONS IN LATTICE THEORY. G.Leibfried and W.Ludwig.
Z. Phys., Vol. 160, No. 1, 80-92 (1960). In German.

The equilibrium conditions of an infinite crystal lattice resu in symmetry relations of lattice sums. This was first shown by Kun Huang (Abstr. 9034 of 1950) who obtained these relations by comparing the linear theory of elasticity with the corresponding limit of lattice theory, a procedure which has been criticized by some authors. It is shown here how one can obtain Kun Huang's results by using only trivial invariance properties of the potentia energy. The same method is applied to get equilibrium relations for higher order (anharmonic) terms of lattice theory which are symmetry relations of tensors used in non linear elastic theory.

539.2 : 53

17882 BROADENING OF THE MÖSSBAUER LINE. H.S.Snyder and G.C.Wick.
Phys. Rev., Vol. 120, No. 1, 128-9 (Oct. 1, 1960).

The thermal excitation of the solid which leads to a temperature-dependent shift of the Mössbauer line could conceivably cau a broadening of this line. Here it is shown, by a quantum-mecha ical treatment, that for a perfect crystalline solid such a broade does not occur.

539.2 : 53

17883 ACOUSTICALLY MODULATED γ RAYS FROM Fe^{57} S.L.Ruby and D.I.Bolef.
Phys. Rev. Letters, Vol. 5, No. 1, 5-7 (July 1, 1960).

The effect of acoustically generated phonons on the γ-ray spectrum emitted by lattice nuclei was studied in order to invest gate the interaction between phonons and the emitting nuclei. E.A.Sande

539.2 : 53

ON THE THEORY OF THE RESONANCE INTERACTION OF γ-QUANTA IN CRYSTALS. See Abstr. 15520

5

17884 ULTRASONIC ABSORPTION IN SOLIDS. T.S.Hutchison.
Science, Vol. 132, 643-52 (Sept. 9, 1960).

Review article with 31 references.

5

17885 ANISOTROPY IN ULTRASONIC ATTENUATION IN SINGLE CRYSTAL ALUMINUM. N.G.Einspruch.
Acta metallurgica, Vol. 8, No. 3, 216 (March, 1960).

Measurements of attenuation in high purity aluminium singl crystal are compared with the prediction of Granato and Lücke t internal friction due to dislocations should be sensitive to cryst orientation. The sequence of magnitudes of five measured atten tions and the closeness in values for the measurements of shear wave in [001] and fast shear wave in [110] agree with theory. V.J.Hamr

539.2

86 ON THE INTERACTION OF ACOUSTIC VIBRATIONS IN IONIC AND ELECTRO-IONIC PLASMAS.

ryanov and E.G.Skrotskaya.
erdogo Tela, Vol. 2, No. 6, 1316-20 (June, 1960). In Russian.
he author discusses non-linear effects in the theory of sound in an ionic crystal or a metal, by applying the collective- nate method to a system of particles with screened Coulomb ctions. In this way the mean free path of phonons, the phonon bution to the heat conductivity, and the relaxation time of the gas are estimated. O.Penrose

539.2

87 POSSIBILITY OF MOLECULAR RESONANCE ACOUSTIC ABSORPTION IN SOLID CYCLOHEXANE.

erma and S.K.Joshi.
Phys. Soc., Vol. 75, Pt 6, 935-7 (June, 1960).
is predicted that this absorption may be of larger magnitude nat in benzene (Abstr. 5455 of 1959). J.Hawgood

539.2

888 TRANSPORT IN METALS. II. EFFECT OF THE PHONON SPECTRUM AND UMKLAPP PROCESSES IGH AND LOW TEMPERATURES. M.Bailyn.

. Rev., Vol. 120, No. 2, 381-404 (Oct. 15, 1960).
or Pt I, see Abstr. 4008 of 1959 . A calculation of the non- etic transport coefficients of the alkali metals is made, with ovements designed to take into account the effect of the phonon rum on both the normal and umklapp regions of scattering. honon equations of motion are solved numerically to obtain a rum sample, and spectrum averages are then computed in a er similar to specific heat calculations, although the density of s is not needed and is not computed directly. No average Debye eratures are used, but rather the sums are obtained in terms of in combinations of the elastic constants, which in principle measurable. Also, improvements on the shielding part and on on part of the electronic matrix elements are calculated and ssed. The results show that umklapp processes are important to the lowest measurable temperatures in the ideal component electrical and thermal resistivities, being completely nant in the former. The low-temperature temperature depen- is therefore determined mainly from the umklapp term, which how a faster variation than T^5 in the electrical resistivity, as tually observed in sodium. The transverse phonon vibrations nate the contributions at all temperatures and even the non- app term at low temperatures. The computations give absolute itudes for the resistivities which are much too large at low eratures. This is tentatively attributed in part at least to a trum which perhaps exaggerates the anisotropy of the transverse ons. General expressions for the transport coefficients are lated via the Kohler variational principle which are not ricted to the model of spherical energy surfaces. A general ession for the phonon-drag term in the thermoelectric power is .

539.2

7889 THERMAL STRESSES IN THE CRYSTALLINE MEDIUM. J.Laval.

ys. Radium, Vol. 20, No. 6, 577-88 (June, 1959). In French.
Interatomic forces developed by thermal agitation do not obey e's law. Consequently, by oscillating, the atoms exert on one her repulsive forces which are sensibly constant over a period me. The thermal stresses which two parts of a crystal exert ach other are equal to the resultants, referred to unit area, of repulsive forces exerted by the atoms of one part upon the atoms e other. By this definition, it is possible to estimate the thermal sses as a function of the temperature and of the fundamental erties of the crystalline medium: its potential energy and its entary translations. It is found that, at low and intermediate peratures, thermal stresses are proportional to the squares of average quadratic amplitudes of the fundamental thermal llations.

539.2 : 536.63

17890 THE TEMPERATURE DEPENDENCE OF THE SPECIFIC HEAT OF DISORDERED Ni_3Mn ALLOY.

.Volkenshtein and Yu.N.Tsiovkin.
. Metallov i Metallovedenie, Vol. 9, No. 2, 311-12 (Feb., 1960). ussian.
The temperature dependence of specific heat, C_p, and the elec- al resistance, R, of disordered Ni_3Mn was determined from 70° to 180°K. The transition from the paramagnetic to the ferromagnetic state, taking place in disordered Ni_3Mn at approximately 110°K, was indicated by a deflection on the R/T curve; a corresponding jump on the C_p/T curve indicated that the transition is a phase transformation of the second order. M.H.Sloboda

539.2

17891 THE HEAT CAPACITY OF LITHIUM CHLORIDE FROM 15 to 325 DEGREES KELVIN. D.A.Shirley.

J. Amer. Chem. Soc., Vol. 82, No. 15, 3841-3 (Aug. 5, 1960).

The heat capacity of lithium chloride has been measured in the temperature range 15-325°K. The data are analyzed in terms of an optical branch model and found to agree qualitatively but not quantitatively with this model. A relationship derived from this model between heat capacity and elastic constants is found to be obeyed roughly by several alkali halides. For LiCl, $S_{298.15}$ is -14.17 ± 0.02 gibbs/mole.

539.2

17892 THE LIMITING LOW-TEMPERATURE BEHAVIOUR OF THE HEAT CAPACITY OF GRAPHITE.

P.Flubacher, A.J.Leadbeater and J.A.Morrison.
J. Phys. Chem. Solids, Vol. 13, No. 1-2, 160-3 (May, 1960).

Experimental results for the heat capacity of graphite previously presented by De Sorbo and Nicholls (Abstr. 8054 of 1959) and by Keesom and Pearlman (Abstr. 8714 of 1955) are re-examined. It is claimed that a consistent explanation can be obtained by regarding the limiting low temperature expression as the sum of a linear electronic term, a T^3 lattice term and a T^2 term representing the effect of particle size. J.W.Leech

539.2

17893 AN ANOMALY IN THE HEAT CAPACITY OF CHROMIUM AT 38.5°C.

R.H.Beaumont, H.Chihara and J.A.Morrison.
Phil. Mag. (Eighth Ser.), Vol. 5, 188-91 (Feb., 1960).

The shape of the curve is of a lambda-type anomaly. At the maximum the excess specific heat is estimated as 0.15 cal/g atom deg, which falls within the upper and lower bounds calculated from changes in other relevant properties, namely 0.05 and 0.30 cal/g atom deg respectively. The shape and position of the anomaly are consistent with the antiferromagnetic transition found at about 40°C. R.Berman

539.2

17894 SPECIFIC HEAT OF THORIUM AT HIGH TEMPERATURES. D.C.Wallace.

Phys. Rev., Vol. 120, No. 1, 84-8 (Oct. 1, 1960).

The specific heat and electrical resistivity of high-purity thorium were measured from room temperature to 1000°C. The specific heat was measured by an electrical pulse-heating method. The results were analysed in terms of additive lattice and electronic specific heats.

539.2 : 539.3

17895 SPECIFIC HEAT AND ELASTIC CONSTANTS OF SODIUM IODIDE AT LOW TEMPERATURES.

R.N.Claytor and B.J.Marshall.
Phys. Rev., Vol. 120, No. 2, 332-4 (Oct. 15, 1960).

Measurement of specific heat from 2.4° to 8°K and of elastic constants from 4.2° to 300°K were made on single crystals of sodium iodide. The Debye theta at 0°K, θ_0, as calculated from the specific heat data is 163 ± 1°K. Values of the elastic constant at 4.2°K are $C_{11} = 3.761$, $C_{12} = 0.798$, and $C_{44} = 0.781$ in units of 10^{11} dynes/cm^2. θ_0 calculated from the velocity of sound waves is 167 ± 1.5°K. The manner in which the experimental specific heat compares with the work of Berg and Morrison and with the theoretical concepts of Barron and Morrison (Abstr. 1556 of 1960) is discussed.

539.2

17896 LOW-TEMPERATURE SPECIFIC HEAT OF BODY-CENTERED CUBIC ALLOYS OF 3d TRANSITION ELEMENTS. C.H.Cheng, C.T.Wei and P.A.Beck.

Phys. Rev., Vol. 120, No. 2, 426-36 (Oct. 15, 1960).

The electronic specific heat coefficient was measured in the temperature range 1.4° to 4.2°K for 48 solid solution alloys in the following binary systems: Ti—V, V—Cr, V—Fe, Cr—Mn, Cr—Fe, and Fe—Co. The electronic specific heat versus electron concentration curves show three quite well separated regions of high density of states. The first of these occurs in alloys with atomic magnetic moments near zero. The second one is found in alloys which have increasing magnetic moments with increasing electron concentration, up to Fe + 35% Co along the Pauling—Slater curve. The third region of high density of states extends from Fe + 35% Co to the limit of the b.c.c. solid solutions at Fe + 75% Co, a range where the magnetic moment decreases with increasing electron concentration.

539.2

17897 SOME OBSERVATIONS REGARDING THE RELATION BETWEEN THE SPECIFIC HEAT AND THE THERMAL CONDUCTIVITY OF METALS (SOLIDS) AT ORDINARY TEMPERATURE. P.C.Pal.

Proc. Nat. Acad. Sci. India A, Vol. 27, Pt II, 75-86 (March, 1958).

Depending on the practical values, the relation has been obtained purely from a graphical method by arranging the metals into subgroups according to periodic classification. The general equation for a particular subgroup is found to be $S = aK^2 + bK + c$. The curves of subgroups a are concave upwards and those of subgroups b are concave downwards. There is a distinct and regular variation of the constants a, b and c with subgroups a or b and so also the axes of the different curves. Finally, Dulong and Petit's law has been modified from the idea of atom structure and has been applied to obtain the equation $Z \times K^2 = \text{const.}$, for a particular subgroup which follows the practical values. The new formula has been applied to find out the thermal conductivity of metals whose values were not available during the work. The actual values of the thermal conductivity of some of these metals were obtained later and were found to agree very well with the predicted values.

539.2

17898 AN EXPERIMENTAL DETERMINATION OF THE CHARACTERISTIC TEMPERATURE FOR PuO_2.

R.B.Roof, Jr.

J. nuclear Mater., Vol. 2, No. 1, 39-42 (March, 1960).

The characteristic temperature for PuO_2 has been determined by experimentally measuring the reduction in intensity of X-ray diffraction spectra from a specimen as the specimen temperature is increased. In order to evaluate the technique employed, the characteristic temperature of aluminium was also determined. For aluminium, a characteristic temperature of 393°K was obtained, which agrees very well with the value of 390°K obtained from specific heat measurements. The characteristic temperature of PuO_2 was found to be 415°K.

539.2

17899 ANOMALOUS THERMAL EXPANSION OF NH_4NO_3 AT 125.8° AND 84.1°C.

V.Hovi, J.Pöyhönen and P.Paalassalo.

Ann. Acad. Sci. Fennicae A VI, No. 42, 11 pp. (1960).

The transition temperature, the total change of volume and the existence of the hysteresis range have been investigated by means of a dilatometric precision method at the transitions of NH_4NO_3 at 125.8° and 84.1°C. It is shown that the results obtained for the transition temperatures and for the total change of volume at 125.8°C are in good agreement with the previous experimental data. However, a small decrease of the total change of volume at 125.8°C has been observed with increasing time. At the lower transition (84.1°C) the results measured for the transition temperature are in satisfactory agreement with the previous values. With regard to the total change of volume, the result is somewhat greater than those given by Behn (1908) and Bridgman (1915/16). No hysteresis ranges like those described by Connel and Gammel (Abstr. 3498 of 1950) have been observed in the present investigation. The densities and the cubic thermal expansion coefficients of NH_4NO_3 have been determined at the transitions I—II and II—III. It is shown that the highest modification I has the greatest cubic thermal expansion coefficient.

539.2 : 536.41 : 537.2

17900 THE THERMAL EXPANSION, DIELECTRIC CONSTANT AND LOSSES OF ALKALI HALIDE CRYSTALS.

V.V.Panchenko.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 150-60; Disc. 167-9, (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). The expansion coefficient was measured from room temperature to 650-700°C by capacity and quartz dilatometers, the dielectric constant at two frequencies between 10^6 and 10^7 c/s from 20° to 450-500°C with a Q-metre using null and beat methods. In all specimens the temperature variation of tan δ shows two relaxation maxima, moving to higher temperatures at higher frequencies. The activation energies deduced from the shift in the first maxima agree well (except NaF) with those derived at audiofrequencies by Breckenridge (Abstr. 1231 of 1949; 8723 of 1950). The calculated variation of with temperature is always slower than the experimental. The c agreement may be due to the neglect of long range forces in the theory.

R.Ber

539.2 : 53

17901 THERMAL EXPANSION AT LOW TEMPERATURES. G.K.White.

Nature (London), Vol. 187, 927-9 (Sept. 10, 1960).

Using an improved capacitance technique it has been possib detect displacements of 10^{-9} cm, and to measure thermal expans coefficients down to 1°K ($\sim\theta/100$). The results of preliminary measurements on copper and iron over a range of temperature a reported. These reveal that iron has an appreciable electronic efficient of thermal expansion at the lowest temperature.

P.A.Wa

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17902 THERMAL EXPANSION OF ALUMINUM AT LOW TEMPERATURES. P.G.Klemens.

Phys. Rev., Vol. 120, No. 3, 843-4 (Nov. 1, 1960).

The pressure of the electron gas gives rise to a contributio to the thermal expansion of metals proportional to the dilatation strain derivative of the electronic specific heat. It appears fro the strain dependence of the superconducting phase boundary tha the electronic specific heat of aluminium is extremely sensitive dilatation. This would explain why the thermal expansion of alu inium between 20° and 30°K is much larger than expected from t Grüneisen theory. The extreme sensitivity of the electronic spe heat to strain is not inconsistent with the zone structure of alum

5

17903 THERMAL CONDUCTIVITY OF GERMANIUM FRO 3°K TO 1020°K. G.A.Slack and C.Glassbrenner.

Phys. Rev., Vol. 120, No. 3, 782-9 (Nov. 1, 1960).

In the measurements from 3°K to 300°K, a longitudinal heat method was used; from 300° to 1020°K, a radial flow method employing small samples was used. The advantages and special experimental techniques required in this radial method are disc From 3° to 10°K the results are explained by a simple combinat of boundary plus isotope scattering in which all phonon—phonon processes can be neglected. At all temperatures below 940°K t heat is carried by phonons, but at 940°K a sharp rise in the ther conductivity indicates the presence of a second conduction mechanism which may be electron—hole pairs.

5

17904 ZERO-POINT ENERGY OF AN ELECTRON LATTIC R.A.Coldwell-Horsfall, and A.A.Maradudin.

J. math. Phys. (New York), Vol. 1, No. 5, 395-404 (Sept.-Oct., 1

At very low densities an electron gas in a compensating uni form background of positive charge crystallizes into a b.c.c. lat for which the correlation energy per electron is $(-1.792/r_s)$ ry. At higher densities the first correction to this result arises fro the zero-point energy of the electrons, which can be expanded i terms of the even moments of the frequency spectrum. The firs five nonvanishing moments have been computed and the contribut the zero-point energy from the remaining moments has been est mated using their known asymptotic behaviour. This procedure leads to the value $(2.638/r_s^{3\ 2})$ ry for the zero-point energy per electron. The low temperature specific heat per electron is fou to be $56.21\ kr_s^{9\ 2} \times (kT)^3$ ry. The range of r_s values for which th results should be valid is discussed on the basis of Lindemann's melting formula.

5

17905 STEADY-STATE DISTRIBUTION FUNCTION IN DIL ELECTRON GASES. D.C.Mattis.

Phys. Rev., Vol. 120, No. 1, 52-7 (Oct. 1, 1960).

It is usually assumed that optically created carriers in a ph conductor rapidly thermalize to a Boltzmann distribution, regar of the generation and recombination mechanisms. However, it c be shown that this distribution which is characteristic of thermo dynamic equilibrium is incompatible with the requirements of st state. A variational principle is introduced to find the steady-st distribution, which is found to approach the Maxwell—Boltzmann function in the limit of strong thermal scattering. Interband sca tering is found to be potentially a strong thermalizing influence, addition to the intraband scattering usually considered. For a s model semiconductor, significant deviations from the Boltzmann

ution are found to be possible at temperatures below a few
s Kelvin. This result is then discussed in connection with
n experiments on germanium.

539.2

906 SURFACE PLASMA OSCILLATIONS OF A DEGENERATE ELECTRON GAS. E.A.Stern and R.A.Ferrell.

Rev., Vol. 120, No. 1, 130-6 (Oct. 1, 1960).
ollowing Ritchie (Abstr. 7154 of 1957) the anomalous charac-
ic energy losses of energy lower than the plasmon energy,
ted by some metals, are attributed to quantized surface waves
degenerate electron gas. Although Ritchie's theory has been
ed for an ideal pure metal surface by Powell and Swan (Abstr.
1960) by reflection of high-energy electrons, the trans-
on experiments show a lower energy loss generally. This is
nted for by taking into account the relaxation produced by the
coating on the surface of the metal. In this way, the experi-
l data is completely accounted for without the assumption of
nomalous bulk dielectric properties of the metal. The present
studies the dependence on thickness of the oxide coating, and
ound that a surprisingly thin coating, say only 20 A thick, can
ce a significant effect. It is established that a measurement
dispersion of the energy loss versus angle of scattering in
ansmission experiment would yield a measurement of the
film thickness. A further check on the theory is suggested by
asurement of the angular dependence of the intensity of the low-
characteristic energy loss. A special effect is predicted for
ormally incident fast electrons. It should be found that the
sity pattern should flare away from the plane of incidence.
les these special angular effects it is predicted that because of
ensitivity of the surface plasma oscillations to any surface
g the value of the surface characteristic energy loss can be
d between wide limits by choosing the appropriate coating. In
cular, making double films of two different metals should pro-
surface characteristic energy losses in between the bulk
cteristic energy losses of the two separate metals.

539.2

907 SPIN SUSCEPTIBILITY OF AN ELECTRON GAS. P.A.Wolff.

. Rev., Vol. 120, No. 3, 814-19 (Nov. 1, 1960).
The generalized random-phase approximation is used to investi-
the effects of electron—electron interaction on the spin suscepti-
of an electron gas. Within this approximation, the induced spin
ty is determined by the solution of an integral equation that
ribes exchange scattering between virtually excited particles.
ions to this equation are obtained in simple cases. They indicate
he exchange scattering enhances the susceptibility over that
icted by the Ruderman—Kittel formula by factors which, for
ron densities comparable to those found in good metals, are in
ange 1-2. These results can also be derived by summing certain
ses of diagrams in many-body perturbation theory. The structure
ese graphs shows that the random phase approximation takes
unt of the simplest sort of self-energy effect and the simplest
of scattering of virtually excited particles.

539.2 : 539.12

7908 POSITRON LIFETIME IN METALS. A.Bisi, G.Faini, E.Gatti and L.Zappa.

s. Rev. Letters, Vol. 5, No. 2, 59-60 (July 15, 1960).
The mean lifetime of Na^{22} positrons was measured in 18 metals
Z ranging between 4 and 83. A variation of positron lifetime
unting to ±35% was found with reference to the lifetime in
inium. Comparison with theoretical predictions is made.

R.H.Thomas

539.2

7909 TRANSITION BETWEEN METALLIC AND INSULATING STATES FOR AN ELECTRON GAS. APPLICATION TO URITY BANDS AND ANTIFERROMAGNETICS. I.

s Cloizeaux.

hys. Radium, Vol. 20, No. 6, 606-20 (June, 1959). In French.
In a solid, the Bloch approximation becomes invalid when the
ombic repulsion between electrons is not small compared to
bandwidth. Then, as can be shown on a simple model, a
sition from the metallic to the insulating state may occur. Such
sult is obtained by means of a transformation which leads to a
regation of the electrons of opposite spins on two sublattices.
width of the forbidden band and the electron pseudo-levels are
tions of temperature.

539.2

17910 ELECTRONIC STRUCTURE OF BISMUTH TYPE CRYSTALS. II. S.Mase.

J. Phys. Soc. Japan, Vol. 14, No. 5, 584-9 (May, 1959).

For Pt I, see Abstr. 10256 of 1959. Further study of the electronic structure of bismuth-type crystals is made by calculating the energies along some directions in the reduced zone in more detail than in the previous paper, including a discussion of the location of electrons and holes in the Brillouin zone. It is proposed that in the case of bismuth, the electrons are located at each centre of the upper and lower inclined planes of Jones' zone and the holes are located at a particular point on each cross line of side-planes parallel to the c-axis, while in the case of antimony the electrons are located at the same places as in bismuth, but the holes at different (defined) places. Using this model some electric and magnetic properties of the metals and alloys are discussed.

539.2

17911 BAND STRUCTURE OF TRANSITION METALS AND THEIR ALLOYS. J.B.Goodenough.

Phys. Rev., Vol. 120, No. 1, 67-83 (Oct. 1, 1960).

A departure from the conventional approach to the energy-band problem is achieved in three ways. First, it is noted that there is a critical atomic separation $R_c <\sim (2.9 \pm 0.1)$ A such that for $R < R_c$ electrons from atomic 3d orbitals that are directed along a ligand must be treated as collective electrons; for $R > R_c$ the corresponding electrons are localized, Heitler—London electrons. Since the 3d wave-functions are anisotropic, this implies that there may be localized and collective 3d electrons simultaneously present. Second, it is pointed out that localized electrons obey Hund's rule and may therefore contribute an atomic moment. This means the corresponding energy levels, or narrow bands, are split into discrete subbands. Any moment from collective 3d electrons is induced by the simultaneously present localized electrons via intra-atomic exchange. Third, it is asserted that if nearest-neighbour anti-ferromagnetic order can be propagated throughout a lattice and the nearest-neighbour-directed 3d orbitals are half-or-less filled, the collective electrons ($R < R_c$) can be stabilized by bonding-band formation. If the orbitals are more than half filled, the "extra" electrons cannot be stabilized by antiferromagnetic correlations between nearest neighbours. If antiferromagnetic, nearest-neighbour order is not possible, the electrons form a conventional metallic band. These observations provide sharp criteria for Pauli paramagnetism, antiferromagnetism, ferrimagnetism, and ferromagnetism in transition metals and their alloys. They are used to explicitly introduce electron correlations into the construction of qualitative energy diagrams from which semiempirical density-of-states curves are constructed. The resulting model is shown to provide a consistent interpretation of phase stability, magnetic properties, electronic specific heats, Hall effect data, and form-factor measurements for the b.c.c. and close-packed transition metals of the first long period and their alloys. The model is only partially successful for elements of the second and third long periods.

539.2

17912 d BANDS IN CUBIC LATTICES. II. J. Callaway.

Phys. Rev., Vol. 120, No. 3, 731-40 (Nov. 1, 1960).

For Pt I, see Abstr. 13785 of 1959. The results of the previous perturbation theoretic treatment of d-bands in the body-centred cubic lattice (Pt I) are extended in several respects. The methods of the previous calculation are applied to determine energy levels at the points Γ and X in the Brillouin zone of the face-centred cubic lattice. As before, the crystal potential is that of a lattice of point charges, screened by a uniform distribution of electrons. The perturbation expansion of the wave-function of a d-electron is developed for the body-centred cubic lattice. Calculations are reported for two states near the top and bottom of the d-band, including terms of first order in the potential. These functions have the characteristic property that the wave-function of a state near the top of the d-band is more compact than that belonging to a state near the bottom. The energies of four states for the body-centred lattice are computed as a function of the binding parameter Za by a more accurate method that that employed in the previous work, making possible an estimation of the accuracy of perturbation theory and the dependence of bandwidth on binding parameter. The role of crystal field effects in the tight-binding limit is discussed, and the circumstances are determined under which the d-band may split into sub-bands based on functions of different cubic symmetries. Estimation of the value of the binding parameter for which such separation occurs strongly suggests that this split does not occur for the actual transition metals. Finally, the effects of spin-orbit coupling on the band structure are studied in the tight-binding approximation. A formulation of $\vec{k} \cdot \vec{p}$ perturbation theory for d-bands is given.

539.2

17913 GROUND-STATE SPLITTING FOR d^5 ^6S IONS IN A CUBIC FIELD.

M.J.D.Powell, J.R.Gabriel and D.F.Johnston.
Phys. Rev. Letters, Vol. 5, No. 4, 145-6 (Aug. 15, 1960).

Using a computor and full use of group theory a more refined calculation has been performed than that of Watanabe (Abstr. 11601 of 1960). Inclusion of the spin doublets of the d^5 configuration, which were neglected by Watanabe, increases the calculated splitting by almost two orders of magnitude. In the absence of optical absorption and electron spin resonance data on the same material the theory cannot be given a very stringent test. However, comparison with the data available gives fairly good agreement with the model. Using the theory and experimental value of $\partial \log a/\partial \log V$, values of $\partial \log Dq/\partial \log V$ are deduced which are quite different from the value of $-5/3$ predicted by an ionic model. J.M.Baker

539.2

17914 ON THE WIDTHS OF FORBIDDEN BANDS OF ELECTRONIC STATES FOR ONE-DIMENSIONAL PERIODIC FIELDS.

H.Watanabe.
Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 1, 13-17 (June, 1959).

The electronic states of an electron for one-dimensional periodic fields are investigated by assuming three simple forms of periodic potential. The widths of the forbidden bands are obtained by two methods: the exact solution of the Schrödinger equation and the free electron approximation method of Brillouin. It is found that the widths of the forbidden bands obtained by the method of the free electron approximation are generally not in agreement with the widths given by the exact solution, excepting the width of the lowest forbidden band.

539.2

17915 FRINGES IN THE PROXIMITY OF THE K-DISCONTINUITY OF X-RAYS IN ZINC. I. TRANSITION PROBABILITY OF THE ELECTRONS TO THE PERTURBED AND UNPERTURBED BRILLOUIN ZONES.

C.Kurylenko.
Cahiers de Phys., Vol. 14, 119-24 (March, 1960). In French.

The effect of the crystallographic planes on the transition probability of an electron from the K-level to a state between E and (E + Δ E) is examined on X-ray diffraction patterns. The variation of this effect with temperature shows the permanence of a short-distance order at the melting point. L.Pincherle

539.2

17916 EXCITON SPECTRUM OF ALKALI HALIDES.

F.Fischer.
Z. Phys., Vol. 160, No. 2, 194-200 (1960). In German.

From the exciton spectrum of the alkali halides it can be shown that the ^2P-function of the alkali atom seems to be necessary, if one wants to construct certain excitons by means of atomic orbital functions. A relation between the ionization energy of the exciton and the optical dielectric constant has been obtained from experimental data. This is consistent with a hydrogen model of the exciton used in an earlier paper (Abstr. 6036 of 1960).

539.2

17917 POWER-INDUCED SHIFTS OF CYCLOTRON RESONANCES IN THE VALENCE BAND OF GERMANIUM.

B.Levinger and D.R.Frankl.
Phys. Rev. Letters, Vol. 5, No. 1, 12-13 (July 1, 1960).

Measurements at 24 kMc/s show an increase in m^* for the light holes of about 4% when the r.f. electric field strength is increased to about 60 V/cm, and a fall of $\omega\tau$ from about 40 to about 10. The behaviour is independent of magnetic field direction, and agrees approximately with Kane's predictions (J. Phys. Chem. Solids, Vol. 1, 83, 1956). No shift is found in the electron resonances; an unexpected shift is found for some orientations in the heavy-hole resonances, which may be a quantum effect.
R.G.Chambers

539.2

17918 THE PROBLEM OF CYCLOTRON RESONANCE IN TIN.

M.S.Khaikin.
Zh. eksper. teor. Fiz., Vol. 39, No. 2 (8), 513-16 (Aug., 1960). In Russian.

Results of investigations into the effect of the inclination of the constant magnetic field, and of the temperature upon the intensit
of the resonances, are reported. The inclination of the magneti
field with respect to the orientation of the tin crystal was found
have differing effects upon different groups of resonances, and th
is explained by attributing these groups of resonances to electro
in various regions of the Fermi surface. With falling temperatu
the intensity of the resonances is found to increase, and the widt
to decrease. However, it is found that the positions of the resona
are constant below 3° K, and this fact is used to calculate the tru
values of the effective mass corresponding to certain sections of
the Fermi surface. K.G.M.

539

17919 ELECTRON SPIN RESONANCES IN IRRADIATED POTASSIUM AZIDE.

A.J.Shuskus, C.G.Young, O.R.Gilliam and P.W.Levy.
J. chem. Phys., Vol. 33, No. 2, 622-3 (Aug., 1960).

The hyperfine structure and orientation dependence of the
electron spin resonance observed in a single crystal of KN_3 afte
ultraviolet or gamma-ray irradiation suggest that the defects g
rise to the resonance are linear N_4^- ions. E.F.W.Seym

539.2 : 53

17920 NUCLEAR RESONANCE ABSORPTION IN Dy^{161} SITUATED IN Dy_2O_3 AND DYSPROSIUM IRON GARN

S.Ofer, P.Avivi, R.Bauminger, A.Marinov and S.G.Cohen.
Phys. Rev., Vol. 120, No. 2, 406-8 (Oct. 15, 1960).

The recoil-free resonant absorption of the 26 keV γ-ray
($T_{1/2} \sim 3 \times 10^{-8}$ sec) emitted in the decay of Tb^{161} by absorbers
containing Dy^{161} was investigated. High Mössbauer efficiencies a
room temperatures were observed for sources and absorbers in
form of oxide and earth iron garnet. The line shapes obtained w
very broad, of the order of 100 times the natural widths, and
showed no resolved lines. The broad lines are interpreted as du
to a wide complicated hyperfine spectrum whose details have bee
smoothed out by transitions between magnetic sublevels induced
paramagnetic relaxation. In the rare earth iron garnet, the exch
field acting on the rare earth ion should decouple the nuclear and
electron spins. The effective magnetic field at the nucleus in the
rare earth garnet is about 2×10^6 Oe.

Defect Properties

53

17921 CLASSICAL ATOMISTIC ENERGY CALCULATIONS FOR NULL- AND ONE-DIMENSIONAL LATTICE FA

F.Wahl.
Z. Naturforsch., Vol. 15a, No. 7, 616-25 (July, 1960). In German

The strain energy associated with point and line defects is
calculated using classical non-linear lattice statics. Screw and
dislocations are considered as special cases. J.W.L

53

17922 SOME SOLID STATE STUDIES OF SILVER-DOPED WO_3.

M.J.Sienko and B.R.Mazumder.
J. Amer. Chem. Soc., Vol. 82, No. 14, 3508-10 (July 20, 1960).

A material corresponding to $Ag_{0.010}WO_3$ has been isolated fr
the thermal equilibration of WO_3 with various sources of silver.
Single crystal studies indicate that it is orthorhombic (a = 7.35,
b = 3.73 and c = 3.85 A) and that it conducts as a metal between
25 and 600° (specific resistivity increases linearly from 0.072
ohm cm at 25° to 0.155 ohm cm at 600°). The electron mobility
at 25° is 0.44 cm^2/volt sec, which is approximately the same as
that previously observed in thallium tungsten bronze. It is prop
that $Ag_{0.010}WO_3$ represents a defect structure in which a 5d cond
tion band of WO_3 is populated by electrons from the silver atoms
and in which a more symmetric structure of WO_3 has been stabil
by configurational entropy.

5

17923 DEFECTS IN POLYETHYLENE CRYSTALS.

W.P.Slichter.
J. appl. Phys., Vol. 31, No. 11, 1865-8 (Nov., 1960).

Nuclear magnetic resonance measurements have been made
the development of chain motion in linear polyethylene and poly-
methylene crystallized from solution. It is shown that segmenta
mobility is produced at room temperature when the compounds a
heated below the melting point. The changes are rapid and irrev
sible, and are independent of crystallization temperature and co
centration, except at high concentration. The effects are ascrib
the development of defects in the crystalline structure.

539.2

24 HEALING OF MACROSCOPIC DEFECTS ON ROCKSALT MONOCRYSTALS AT HIGH TEMPERATURES.

Geguzin and A.A.Shpunt.
llografiya, Vol. 4, No. 4, 579-86 (July-Aug., 1959).
sian. English translation in: Soviet Physics—Crystallography
York), Vol. 4, No. 4, 541-6 (April, 1960).

diamond indentor was used to produce artificial defects in the
e, and the specimens were then annealed in sealed quartz
e The dent profiles were obtained from interferograms and the
g of the dents is explained by the transfer of solid via the
r phase; thermal annealing in vacuum caused etching confirm-
is view. J.E.Caffyn

539.2

25 THERMALLY ACTIVATED POINT DEFECT MIGRATION IN COPPER.

eechan, A.Sosin and J.A.Brinkman.
Rev., Vol. 120, No. 2, 411-19 (Oct. 15, 1960).

recovery model is presented which includes specific
nments of point defect migration to the various recovery stages
pper. New experimental results showing the effects of prior
vork on the production and subsequent recovery of damage
ced in copper by 10°K and 90°K electron irradiations are also
nted. The most significant observations in these experiments
(1) irradiation recovery Stages I_D and I_E are suppressed by
ous cold work; (2) this suppression is reflected in an increased
ge rate at 90°K; (3) the additional damage which remains in
s I_D and I_E, or which is produced at 90°K, recovers in Stage III;
e recovery in Stage III is altered from the bimolecular process
cteristic of annealed copper; (5) under certain conditions a
-recovery occurs in Stage III so that the measured resistivity
below the pre-irradiation value. These observations are
reted according to this recovery model.

539.2

7926 LATTICE DEFORMATIONS AROUND INTERSTITIAL ATOMS, VACANCIES,INTERSTITIAL ATOM PAIRS FRENKEL PAIRS IN COPPER.

Bennemann and L.Tewordt.
aturforsch., Vol. 15a, No. 9, 772-82 (Sept., 1960). In German.

The distortions of the lattice around a number of different point
ts in copper are calculated using a general method developed
ewordt (Abstr. 1326 of 1958). In the case of an interstitial atom
h is sited at the centre of an elementary cube about 500 atoms
n the case of a vacancy about 50 atoms are treated as discrete
cles. The elastic solutions which are joined to the displace-
s of the discrete particles are determined for an anisotropic
nuum. The changes in volume of the crystal arising from the
stitial are found to be 0.911, 1.219 and 1.441 atomic volumes,
ectively, for the Morse potential V_M and the two Born—Mayer
tials V_1, V_2 used. The corresponding values for the vacancy
−0.441, −0.378 and −0.321 atomic volumes. The relaxation
lculated of the lattice around three configurations of inter-
al pairs with axes in the (1, 0, 0), (1, 1, 0) and (1, 1, 1) direc-
considering about 100 atoms as movable in each case. The
ributions to the binding energies arising from the potential V_1
out to be 0.81, −0.18 and −0.26 eV, respectively. This strongly
ates that interstitial pairs can attract one another. The sta-
y of the 10 closed interstitial-vacancy pairs (Frenkel pairs) is
ained. All pairs smaller than 1.5 lattice constants in diameter
found to be instable, the other pairs are stable and give a dis-
e spectrum of Born—Mayer energies. The results are discussed
nnection with recent experiments in the field of radiation
age.

539.2

17927 DIRECT OBSERVATION OF DEFECTS IN EVAPORATED SILVER. V.A.Phillips.

. Mag. (Eighth Ser.), Vol. 5, 571-83 (June, 1960).

Single-crystal films of silver were made by evaporation of
er onto the cleavage surface of a heated rock-salt crystal. The
stalline defects present in the detached films were studied by
smission electron microscopy. In fresh areas of the foil,
erous simple stacking faults confined to a single plane were
erved. The number varied between 5 × 10^9 and 1 × 10^{10} cm^{-2}.
re was a strong tendency for the partial dislocations to lie in
0⟩ directions. The morphology of the simple fault shapes
ulting is considered in detail. Electron beam stressing resulted
he dissociation of whole dislocations and in the widening of faults
eady present. The interaction of the faults to form complex faults on several planes, and the effects of holes and dislocations were studied. Some areas showed minor defects consisting of dislocation loops and tetrahedral stacking faults. Preliminary annealing experiments indicate that the simple faults are remarkably stable at 300°C. The origin of the various defects is discussed. It is concluded that most simple faults probably form by dissociation of dislocations which may (1) grow in from the substrate, (2) nucleate at silver patch edges during growth, (3) form by impingement of patches on a {110} plane during growth.

539.2

17928 OBSERVATION OF DISLOCATIONS IN TELLURIUM.

A.I.Baum.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1666-8 (July, 1960). In Russian.

Dislocations in Te are revealed by etching. The etchants used included those based on nitric, phosphoric and chromic acids, and the behaviour of the various etchants is compared.

R.S.Hearmon

539.2

17929 OBSERVATION BY X-RAY DIFFRACTION OF DISLOCATIONS IN A DIAMOND. F.C.Frank and A.R.King.

Phil. Mag. (Eighth Ser.), Vol. 4, 383-4 (March, 1960).

An X-ray projection topograph technique is applied and a stereo pair obtained which makes visible the internal dislocations in a diamond. S.Tolansky

539.2

17930 DIRECT OBSERVATIONS OF DISLOCATIONS IN MAGNESIUM OXIDE.

J.Washburn, A.Kelly and G.K.Williamson.

Phil. Mag. (Eighth. Ser.), Vol. 5, 192-3 (Feb., 1960).

Electron transmission microscopy was used to observe the motion of dislocations, and plastic deformation associated with the propagation of cracks in large crystals of MgO. R.F.Peart

539.2

17931 ON THE RELATIONSHIP BETWEEN DISLOCATIONS AND VACANCIES. F.Seitz.

Acta. phys. Hungar., Vol. 8, No. 1-2, 19-24 (1957). In German.

Experimental work on the activation energy of migration and the formation energy of vacancies in gold is reviewed and the probability that a vacancy captured by a dislocation will be annihilated is calculated. Assuming reasonable relationships and values of constants it is shown that the probability of such an annihilation is $\frac{1}{2}$ at about 500°K. An experiment is suggested which may yield a parameter of interest to the discussion of the Kirkendall effect and related experiments. I.Cooke

539.2

17932 CRACKS DUE TO THE PILING-UP OF DISLOCATIONS ON TWO INTERSECTING SLIP PLANES IN MgO CRYSTALS. A.S.Keh, J.C.M.Li and Y.T.Chou.

Acta metallurgica, Vol. 7, No. 10, 694-6 (Oct., 1959)

A new type of crack in MgO and LiF crystals was observed around microhardness indentations. A mechanism for the initiation of such a crack is proposed. R.F.Peart

539.2

17933 DISLOCATION BARRIERS AND CROSS SLIP.

W.F.Hosford and R.L.Fleischer.

Acta metallurgica, Vol. 7, No. 12, 816-17 (Dec., 1959).

Kocks [Ph.D. Thesis, Harvard (1959)] has considered the mobility of the long jogs formed on dislocations of [101] slip vector when cut by primary [101] (111) dislocations moving across their slip plane and has suggested that the long jogs could not move easily because of a high Peierls force. The present authors provide another reason, based on the formation of Cottrell—Lomer barriers, for such jogs to be sessile. R.Bullough

539.2

17934 OXIDE NUCLEI AND DISLOCATIONS.

F.W.Young, Jr.

Acta metallurgica, Vol. 8, No 2, 117-23 (Feb., 1960).

Crystals of 99.999% copper and of copper doped with various impurities were bent so as to introduce regular arrays of dislocations and were oxidized by three techniques in order to determine if there was a correspondence between dislocations and oxide nuclei. For crystals doped with Te or with Sn, and for crystals of OFHC copper it was found that nuclei were formed at dislocations. For 99.999% copper and for copper doped with Si there was no correlation between oxide nuclei and dislocations. Also, oxide nuclei were formed on crystals of all purities which were not related to dislocations.

539.2

17935 CONTRIBUTION OF INTERFACE COUPLES TO THE ENERGY OF A DISLOCATION. F.A.McClintock.

Acta metallurgica, Vol. 8, No. 2, 127 (Feb., 1960).

It is shown that if the major contribution to the energy of a dislocation comes from the elastic region separated from it by one lattice spacing or more, the effect of interface couples can be neglected. R.F.Peart

539.2

17936 THE INTERACTION OF DISLOCATIONS AND PRECIPITATES. R.B.Nicholson, G.Thomas and J.Nutting.

Acta metallurgica, Vol. 8, No. 3, 172-6 (March, 1960).

Thin foils of various aged aluminium alloys have been examined by transmission in the electron microscope. Dislocations, introduced by rolling before thinning, have been observed to move under the action of thermally induced stresses. The interactions of these dislocations and precipitates has been studied and the results show that dislocations pass through zones, coherent and partially coherent precipitates, but not through incoherent precipitates.

539.2

17937 ON THE INTERACTION BETWEEN A FIXED DISLOCATION AND A MOBILE DISLOCATION IN ITS SLIP PLANE. G.Saada.

Acta metallurgica, Vol. 8, No. 3, 200-8 (March, 1960). In French.

A model is proposed for the detailed study of the passage of a dislocation moving in its slip plane through a dislocation "forest". In the absence of exterior constraints, there does not exist, in the slip plane, a stable loop enclosing one of the "trees" of this "forest". It is also shown that the passage of a repulsive "tree" is made without a significant modification of the shape of the line. If slip is not too difficult, the jog created by the passage of a "tree" will produce an appreciable number of vacancies only if the "tree" is attractive. Several applications in the study of hardening are sited. It is shown, in particular, that the dislocations situated in slip planes near those of the moving dislocations exert constraints of the same order as those due to "trees" cutting the slip plane.

539.2

17938 DISLOCATION CONTENT IN EPITAXIALLY VAPOR-GROWN Ge CRYSTALS. H.S.Ingham, Jr and P.J.McDade.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 302-4 (July, 1960).

Single crystal layers of Ge were deposited epitaxially on to Ge seeds by disproportionation of GeI_2 to Ge and GeI_4. The dislocation content of the layers is generally high, and is principally controlled by the condition of the surface of the seed. The perfection of the seed becomes important only if the seed is initially exposed to hydrogen and iodine. Then the layer contains far fewer dislocations, and an almost dislocation-free layer can be deposited on a dislocation-free seed.

C.Hilsum

539.2

17939 DISLOCATION NETWORKS IN A LOW-ALLOY STEEL. A.S.Keh.

J. appl. Phys., Vol. 31, No. 8, 1501-2 (Aug., 1960).

Electron microscope observations of dislocation networks within ferrite grains. L.Pincherle

539.2

17940 DISLOCATIONS IN INDENTED MAGNESIUM OXIDE CRYSTALS. A.S.Keh.

J. appl. Phys., Vol. 31, No. 9, 1538-45 (Sept., 1960).

Dislocation rosette patterns produced by spherical and pyramidal indentors on the cleaved surfaces of magnesium oxide crystals were studied in detail. The three-dimensional arrangement of dislocation loops as deduced from the two-dimensional etching patterns is discussed. Cracks formed on $\{110\}_{90}$ planes around pyramidal indentations are believed to be due to the interaction of dislocations on $\{110\}_{45}$ planes. The temperature dependence of hardness was found to be related to the widening of dislocation bands, rather than to the distance of travel of leading dislocations. Some observations were also made on the pinning of dislocations and recovery at elevated temperatures, and on the interaction of dislocations with grown-in subboundaries.

539.2

17941 DISLOCATION RIBBONS AND STACKING FAULTS IN GRAPHITE. P.Delavignette and S.Amelinckx.

J. appl. Phys., Vol. 31, No. 9, 1691-2 (Sept., 1960).

Dissociated dislocation ribbons in the basal plane of graphite were observed by direct transmission electron microscopy. The stacking fault energy E was 3.5-5 × 10^{-2} ergs cm^{-2} calculated from the curvature of a partial and from the separation between two partials. The Burgers vectors were obtained from the variations in contrast occurring at different orientations.

J.Fra

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17942 EFFECT OF THERMAL HISTORY ON THE DISLOCA TION SUBSTRUCTURE NEAR THE SURFACES OF A LITHIUM FLUORIDE CRYSTAL. J.M.Schultz and J.Washburn.

J. appl. Phys., Vol. 31, No. 10, 1800-1 (Oct., 1960).

A series of X-ray and etch pit experimental has been perfor to determine some of the effect of temperature on the perfection surface layers in LiF. It was found that the perfection of a cleav surface is substantially increased at temperatures near the melt point, that rearrangement and annihilation of dislocations takes place at much lower temperatures, and that rapid cooling promot the formation of shallow dislocation loops.

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17943 DISLOCATIONS IN α-IRON. D.G.Brandon and J.Nutting.

J. Iron Steel Inst., Vol. 196, Pt 2, 160-6 (Oct., 1960).

Electron optical examination of the dislocation distribution pure α-iron after different amounts of plastic deformation shows that irregular sub-boundary networks are formed. In coarse-gr material these sub-boundaries are partially responsible for wor hardening.

53

17944 DISLOCATION RELAXATION IN ZINC SINGLE CRYSTALS. P.G.Bordoni, M.Nuovo and L.Verdini.

Nuovo Cimento, Vol. 16, No. 2, 373-7 (April 16, 1960).

A temperature dependence relaxation effect was observed a was related to the presence of dislocations by investigating the influence of pre-annealing and pre-compressional strain on the attenuation as a function of temperature. The activation energy W of the relaxation process was estimated to be 0.33 eV.

R.F.Pe

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17945 FRICTIONAL STRESS ACTING ON A MOVING DISLOCATION IN AN OTHERWISE PERFECT CRYS D.Kuhlmann-Wilsdorf.

Phys. Rev., Vol. 120, No. 3, 773-81 (Nov. 1, 1960).

The problem is investigated without calculating the core ene of dislocations, but by considering stresses and strains on the sl plane. The level of frictional stresses obtained is much higher reported previously. Since common glide dislocations in metals close packed structures apparently do not suffer significant frict stresses, mechanisms are discussed which tend to reduce their A new such mechanism is discovered. It is based on the idea th positions of dislocation axes are not defined with precision, but within one to a few times the average displacement of the oscilla atoms. The expected result of this is a depression of the frictio stress for close packed metals even at very low temperatures, a no effect on dislocations in crystals with diamond structures, an temperature dependence proportional to exp(−const. × T/T_M) fo NaCl type salts and, probably, for b.c.c. metals.

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17946 DISLOCATION LOOPS DUE TO QUENCHED-IN POIN DEFECTS IN GRAPHITE.

S.Amelinckx and P.Delavignette.

Phys. Rev. Letters, Vol. 5, No. 2, 50-1 (July 15, 1960).

Graphite crystals were given heat treatments of 2 min at 2700°-3000°C. After quenching and annealing at 1200°C, dislocat loops were observed by the use of transmission electron micros The point defects involved are considered to be vacancies rather than interstitials. R.F.Pe

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17947 CHLORINE AND IODINE AS IMPURITIES IN InAs AN GaP. G.R.Antell.

J. appl. Phys., Vol. 31, No. 9, 1686 (Sept., 1960).

Mass spectrometer analysis shows that iodine has a low solubility in GaP and that chlorine has a high solubility in InAs. These results are consistent with ideas of covalent radii of I and Cl. C.A.Hoga

539.2

948 TEMPERATURE GRADIENT GRAIN BOUNDARY MIGRATION. C.Elbaum.

metallurgica, Vol. 7, No. 9, 651-2 (Sept., 1959).

he migration towards the higher temperatures is explained by gy with the phenomenon of zone-melting, the grain boundary assumed to be a second phase. A.E.Kay

539.2

949 ABSOLUTE GRAIN BOUNDARY ENERGIES IN COPPER. R.L.Fleischer.

metallurgica, Vol. 7, No. 12, 817-18 (Dec., 1959).

n a recent paper [Acta metallurgica, Vol. 7, 319 (1959)] ein and Rhines have concluded that the Read—Shockley formula e energy of a grain boundary was only appropriate for small s of misorientation in copper. The present author suggests onclusion is incorrect and that the Read—Shockley formula is valid for large angles of misorientation; it is suggested that mperature dependence of the elastic constants was not correct-owed for and also that a small twist component may exist in oundary. An estimate of the reduction of boundary energy due growth of impurity atmospheres there is also given.

R.Bullough

539.2

7950 POLYGONIZATION OF 31% ALPHA-BRASS. V.Y.Doo.

metallurgica, Vol. 8, No. 2, 106-11 (Feb., 1960).

31% alpha-brass crystals grown by melting high purity copper inc together were used in this investigation. Single crystals within, as well as slightly beyond, the single slip region were gonized to form dislocation walls perpendicular to the major f slip planes after a final anneal of 1-2 hr at 700°C or 750°C. polycrystalline specimens having very high dislocation den-s in all sets of active slip planes were polygonized to form sub-boundaries after a similar anneal. Even though the stacking energy of alpha-brass is likely to be lower than that of the er, the former polygonized at a relatively lower temperature. believed that the high self-diffusivity of alpha-brass is one of mportant factors which facilitated the climbing of its disloca-. The present results substantiated Barnes' prediction that the ociated dislocations can climb.

539.2

7951 STUDY OF IMPERFECTIONS IN A SINGLE CRYSTAL BY THE USE OF SCATTERED LIGHT. L.Taurel.

hys. Radium, Vol. 20, No. 11, 919-20 (Nov., 1959). In French.

The crystal is illuminated by a fine pencil of light and micro-e observations are made of the scattering at 90° by imperfec-s in the crystal. Examples are given of two photomicrographs n in this way with ultraviolet light. J.Thewlis

539.2

17952 VACANCY PRECIPITATION IN QUENCHED GOLD FROM INTERNAL FRICTION MEASUREMENTS.

amel.

a metallurgica, Vol. 7, No. 10, 680-1 (Oct., 1959).

Internal friction measurements were made at room temperature gold strip, after quenching it from temperatures between 400° and °C. For material quenched from below 700°C, the excess intern-riction decayed exponentially; from above 700°C, the decay is re complex. The results are discussed in terms of vacancies pped by quenching, which anihilate at dislocation lines and by ming ring dislocations. H.Mykura

539.2

17953 THE PRODUCTION OF VACANCY CLUSTERS DURING COLD WORK. A.C.Damask and G.J.Dienes.

a metallurgica, Vol. 7, No. 12, 818-19 (Dec., 1959).

A semi-quantitative argument is put forward which suggests t divacancies may play an important role in the low-temperature ealing of cold work in Cu. R.F.Peart

539.2

17954 QUENCHING OF VACANCIES IN SILVER. Y.Quere.

R. Acad. Sci. (Paris), Vol. 251, No. 3, 367-9 (July 18, 1960). In ench.

The increases in the electrical resistivity of quenched wires were measured at low temperatures and are shown to fit the equation

$$\Delta\rho = \Delta\rho_0 \exp(-E_f/kT),$$

where T is the absolute temperature of the wire before quenching. E_f, the energy of formation of a vacancy, was found to be 1.06 ± ± 0.07 eV, and $\Delta\rho_0 = (4.9 \pm 1.5) \times 10^{-4}$ ohm cm. D.G.Holloway

539.2

17955 STUDY OF QUENCHING AND MOVEMENT OF VACANCIES IN SILVER AND PLATINUM BY THE THERMO-E.M.F. METHOD. S.D.Gertsriken and N.N.Novikov.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 224-35 (Feb., 1960). In Russian.

The activation energies for the formation and movement of vacancies, Q_1 and Q_2 respectively, were determined from measurements of the thermo-e.m.f., generated by a couple formed by slowly cooled and quenched metal. Q_1 and Q_2 were respectively 23 200 ± 600 and 19 200 ± 200 cal/mole for Ag, and 32 600 ± 1000 and 30 200 ± 1000 and 32 200 ± 300 cal/mole for Pt. In each case $(Q_1 + Q_2)$ was equal to the activation energy for self-diffusion in the metal studied. It was inferred from these results that the vacancy sinks, provided most likely by dislocations, were situated in the interior of the specimens. M.H.Sloboda

539.2

17956 THE GENERATION OF VACANCIES IN METALS. R.S.Barnes.

Phil. Mag. (Eighth Ser.), Vol. 5, 635-46 (June, 1960).

The regions where injected helium atoms first appear as gas bubbles are those where thermal vacancies originate. Microscopic examination of metals, injected with helium by using them as targets for energetic alpha-particles, reveals grain boundaries as the principal suppliers of vacancies. Detailed examination distinguishes those boundaries which generate vacancies from those which merely conduct them. The behaviour and nature of these boundaries and other vacancy sources are discussed.

539.2

17957 THEORY OF VACANCY ANNEALING IN IMPURE METALS. A.C.Damask and G.J.Dienes.

Phys. Rev., Vol. 120, No. 1, 99-104 (Oct. 1, 1960).

The general equations for the annealing of vacancies in metals containing impurities to which the vacancies can be attached have been solved on an analogue computer for a wide variety of parameters. The computer results show that some simplifying assumptions may be made which permit the general equations to be solved analytically. It is shown that for many physically interesting cases of vacancy migration the decay curve is exponential, and the decay constant is related to, but not equal to, the rate constant for vacancy migration. It is further shown that only experiments performed on zone-refined metals can give the correct vacancy migration energy, and that impurity contents as low as 10^{-5} can seriously affect the results. Experimental methods and calculations are discussed which can be used to measure the binding energy of vacancies to impurities in metals prepared by controlled doping.

539.2

17958 VACANCY—VACANCY INTERACTION IN COPPER. V.G.Weizer and L.A.Girifalco.

Phys. Rev., Vol. 120, No. 3, 837-9 (Nov. 1, 1960).

The binding energy of two vacancies in a static lattice as a function of their separation and the positions of their displaced neighbouring atoms has been calculated using a Morse potential function model for copper. It was found that two vacancies attract one another at separation less than about 7 A. At separations greater than 7 A the vacancies do not interact appreciably. The most stable separation was found to be the first-nearest-neighbour separation or the divacancy configuration, for which the binding energy was found to be 0.64 eV. Based on these calculations, it is shown that third-stage annealing in irradiated copper may be accounted for by divacancy migration. The role of the divacancy in copper self-diffusion is also explained.

539.2

17959 VACANCY INTERACTION IN SILICON. H.H.Woodbury and G.W.Ludwig.

Phys. Rev. Letters, Vol. 5, No. 3, 96-7 (Aug. 1, 1960).

Spin resonance techniques were used to study the trapping and annihilation of vacancies by interstitial impurities.

P.T.Landsberg

539.2

17960 ELECTRONIC STRUCTURE OF TRANSITION METAL IONS IN A TETRAHEDRAL LATTICE.
G.W.Ludwig and H.H.Woodbury.
Phys. Rev. Letters, Vol. 5, No. 3, 98-100 (Aug. 1, 1960).

The electronic structures of various 3d transition metal ions as impurities in Si are deduced from two general assumptions. The orbital degeneracies and electron spin values corresponding to the proposed structures agree with electron spin resonance measurements. It appears that the occupation of the 3d shell depends very much on the charge state of the ion and on whether it is substitutional or interstitial. A feature of the basic assumptions is that for interstitial ions the t_2 level is postulated to lie below the e level. D.M.Edwards

539.2

17961 THEORETICAL INVESTIGATIONS OF VACANCY COMPLEXES IN THE NOBLE METALS. G.Schottky.
Z. Phys., Vol. 159, No. 5, 584-601 (1960). In German.

The binding energies of threefold complexes are investigated. The electrons are treated as quasi-free and the Schrödinger equation is solved using the partial waves method. The interactions of the ion cores are represented by a Born—Mayer potential. Threefold complexes are found to have binding energies approximately three times those of twofold ones. Triangular arrangements and tetrahedral ones with a central atom are both considered; either may represent the more stable form depending upon the details of the potential. Entropy and displacement energy are also discussed briefly. J.W.Leech

539.2

17962 MECHANISM FOR THE PRODUCTION OF F-CENTERS IN NaCl BY IRRADIATION WITH GAMMA RAYS.
J.H.Crawford, Jr and F.W.Young, Jr.
J. appl. Phys., Vol. 31, No. 9, 1688-9 (Sept., 1960).

By examining etch pits in a NaCl crystal before and after γ-ray irradiation, it is concluded from the absence of observable movement that the mechanism proposed by Seitz for the production of F-centres (Abstr. 9755 of 1954), namely the evaporation of vacancies from the dislocations, can only apply to an insignificant fraction of the F-centres produced. L.Mackinnon

539.2 : 539.12

GAMMA-RAY EFFECTS ON GaAs : USE FOR GAMMA-RAY SPECTROSCOPY. See Abstr. 17287

539.2

17963 MECHANISM FOR COLORATION OF ALKALI HALIDES AT LOW TEMPERATURES. C.C.Klick.
Phys. Rev., Vol. 120, No. 3, 760-2 (Nov. 1, 1960).

A mechanism for low-temperature coloration of alkali halides is proposed in which double ionization of a halide ion or single ionization of two adjacent ions leads to the formation of an uncharged halogen molecule which occuupies two adjacent halide ion sites. If the molecule is localized at one of these sites by the jump of a nearby halide ion into the other site, a vacancy and interstitial are formed. Capture of an electron by each of these imperfections leads to the production of the F-centre and H-centre.

539.2

17964 THE THERMAL REORIENTATION OF THE M CENTER. T.Ishii.
Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 2, 67-73 (Aug., 1959).

The change of the dichroism of the M band caused by the thermal reorientation of M centres is calculated. The results are compared with the experimental facts reported previously. It is suggested that the dipole matrix element of an M centre is oriented along one of the face diagonals of the crystal and it reorients thermally to five other possible orientations with the same probability. The crystal considered throughout is KCl.

539.2

17965 HIGHER EXCITED STATES OF COLOUR CENTRES. F.Lüty.
Z.Phys., Vol. 160, No. 1, 1-15 (1960). In German.

In additively coloured KCl, KBr, KI, RbCl, RbBr and RbI the absorption on the short-wave side of the F-band was investigated. Besides the K band, three new absorption peaks L_1, L_2 and L_3 were found all in a fixed relation to the F band. The experimental data indicate that K, L_1, L_2 and L_3 are transitions of the F electron to higher excited states, the three highest of which are conductive states. By comparing the absorption band areas the relative transition probabilities to the different excited states were obtained.

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17966 RADIOTRACER STUDIES OF THE INCORPORATION OF IODINE INTO VAPOR-GROWN Ge.
W.E.Baker and D.M.J.Compton.
I.B.M. J. Res. Developm., Vol. 4, No. 3, 269-74 (July, 1960).

Measurements of the incorporation of iodine into single crys of Ge grown by the disproportionation of GeI_2 have been made us I^{131} as a radioactive tracer. The results show that I is not likely to be a hindrance to device use of this material since the amount incorporated is moderately low (10^{14}-10^{15} atoms/cm^3), and does appear to be correlated with electrical effects. It does not diffus appreciably ($D_{975^\circ} < 10^{-13}$cm^2/sec). No excess is found at an all deposited p—n junction. The concentration of I incorporated appe to decrease with increasing temperature, to be independent of gr rate on a (111) orientation of the seed, but to vary by a factor of u to 50 from one orientation to another. It is deduced that the I is incorporated by a mechanism intimately connected with the cryst growth.

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17967 INCORPORATION OF As INTO VAPOR-GROWN Ge. W.E.Baker and D.M.J.Compton.
I.B.M. J. Res. Developm., Vol. 4, No. 3, 275-9 (July, 1960).

The incorporation of arsenic into single-crystal germanium grown by the disproportionation of GeI_2 was studied using As^{76} as radioactive tracer, and using measurements of the Hall effect. T deposition was carried out in a sealed tube using as source mate a single crystal of Ge doped to 2.5×10^{19} atoms/cm^3 with As. It was found that all the As incorporated into the vapor-grown Ge w electrically active, at least for material grown on a (211) Ge see The concentration of As in the deposited Ge was lower than that i the source, and appeared to depend on the crystallographic orient tion of the growing face.

53

17968 REMARKS ON THE USE OF INERT MARKERS FOR THE STUDY OF DIFFUSION IN PLASTIC PHASES.
M.Cagnet and J.Moreau.
Acta metallurgica, Vol. 7, No. 6, 427-9 (June, 1959). In French.

Criticizes the experiments of Wever and Engell on the oxida of Fe [Acta metallurgica, Vol. 5, 695 (1957)] and their conclusion that O diffuses through the FeO layer. The paper includes resul of experiments using other methods of placing marker wires at t initial Fe surface. D.G.Hollo

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17969 REPLY TO THE LETTER TO THE EDITOR OF MESSRS. CAGNET AND MOREAU.
F.Wever and H.J.Engell.
Acta metallurgica, Vol. 7, No. 6, 429 (June, 1959). In German.

See preceding Abstract. Replies to criticisms and suggests alternative explanation for the displacement of the marker wires their experiments on the oxidation of Fe. D.G.Hollo

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17970 RELATION BETWEEN THE SEGREGATION OF IMPURITIES AND INTERGRANULAR SELF-DIFFUSI IN IRON. P.Coulomb, C.Leymonie and P.Lacombe.
Acta metallurgica, Vol. 7, No. 10, 691-3 (Oct., 1959). In French.

Autoradiographic techniques were used to study the effect of the relative orientation of adjacent grains on the self-diffusion ar precipitation of impurities in grain boundaries. R.F.Pe

53

17971 DIFFUSION OF ANTIMONY IN COPPER SINGLE CRYSTALS. M.C.Inman and L.W.Barr.
Acta metallurgica, Vol. 8, No. 2, 112-16 (Feb., 1960).

The rate of diffusion of antimony in copper single crystals h been measured over the temperature range 600°-1000° C by mean of a sectioning technique employing the Sb^{124} radio-isotope as tra The diffusion activation energy and frequency factor were found be 42000 ± 700 cal mole^{-1} and 0.34 ± 0.12 cm^2 sec^{-1}. This resul compared with existing data on the diffusion of impurity atoms in copper.

53

17972 DIFFUSION SPREADING AND THE PHENOMENON C REACTIVE CONDENSATION. B.Ya.Pines and I.G.Iv
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 205-11 (Feb., 1960) In Russian.

To elucidate the part played in surface diffusion by evaporat

ondensation, the spreading of a drop of a liquid metal on the
surface of another metal was studied. When the experiments
conducted in H, and when the two metals employed formed
netallic compounds, spreading of the liquid drop was accom-
i by the appearance of several concentric rings of various
s, formed on the solid metal surface. No such effect was
ved in the absence of the formation of intermetallic compounds
en the spread-of-a-drop tests were carried out in vacuum.
ron diffraction analysis showed that the appearance of concen-
ings during spreading of Cd on Cu was due to the formation of
$_3$ and Cu_5Cd_8. It was concluded that under favourable conditions
e diffusion can take place by the mechanism of "reactive
nsation", i.e. condensation accompanied by a reaction between
lid phases. M.H.Sloboda

539.2

973 INVESTIGATION OF REACTIVE DIFFUSION IN METAL-COMPOSITE GAS SYSTEMS. I. GENERAL CONSIDER-
NS. V.I.Arkharov and V.N.Konev.
Metallov i Metallovedenie, Vol. 9, No. 2, 212-15 (1960).
ssian.

heoretical. The mechanism of the interaction between chem-
active gases and metal surfaces is discussed with particular
ence to the effect of factors such as: (1) the constitution diag-
of the metal—(X' + X'') system, where X' and X'' are two
e gases with or without an addition of other, inert gases;
e crystal structure of the metal; (3) and the presence or
nce of stable structural defects. M.H.Sloboda

539.2

7974 SELF-DIFFUSION OF THE CHLORIDE ION IN SODIUM CHLORIDE. N.Laurance.
s. Rev., Vol. 120, No. 1, 57-62 (Oct. 1, 1960).

The diffusion coefficient of Cl^{36} in NaCl was measured in the
perature range from 520° to 740° C. Diffusion was measured in
Harshaw crystals and in crystals containing from 0.01 to
mole % calcium. The diffusion coefficient in pure crystals is
esented by the equation $D = 56 \exp(-2.12\ eV/kT)\ cm^2/sec$.
diffusion coefficient in crystals containing calcium was smaller
that measured in pure crystals by a factor of from 5 to 10, and
an activation energy of 2.5 eV. Over the range of impurity con-
ration employed the diffusion coefficient was insensitive to
rences in calcium concentration. The results are discussed in
s of motion of free negative ion vacancies and of vacancy pairs.
sible complicating effects of dislocation lines on the diffusion
ficient are also considered.

539.2

7975 LATTICE AND GRAIN BOUNDARY DIFFUSION IN CADMIUM BY A TRACER METHOD.
amel and K.A.Mahmoud.
c. Math. Phys. Soc. Egypt, No. 22, 65-70 (June, 1958).

The self-diffusion for pure polycrystalline and single crystal
mium specimens was measured at different temperatures by the
face activity decrease method. Cadmium disks of diameter 3 cm
thickness 0.3 cm were electroplated on one side with a thin
r of Cd^{115}. The diffusion coefficient was calculated at each
perature for different annealing times. It was found that for
crystalline samples the grain-boundary diffusion coefficient is
nction of the diffusion time as well as the diffusion temperature.
iew of this behaviour, it is thought that the concept of an acti-
on energy associated with grain-boundary diffusion has little
ificance. The temperature dependence of the lattice diffusion
fficient in single crystals is given by $D = 0.14 \exp. (-19700/RT.)$
cordance with previous data.

539.2

17976 DIFFUSION OF LITHIUM THROUGH TUNGSTEN. G.M.McCracken and H.M.Love.
s. Rev. Letters, Vol. 5, No. 5, 201-2 (Sept. 1, 1960).

The diffusion coefficients of Li^7 and Li^6 in polycrystalline tung-
n were measured. Natural lithium was deposited on one side of a
gsten ribbon and atoms which diffused to the other side were ion-
d and detected with a mass spectrometer. The activation energy is
2 ± 0.05 eV and D_0 for the diffusion of Li^7 is $82 \pm 40\ cm^2\ sec^{-1}$.
D_7 is 1.07 ± 0.02, a value consistent with interstitial diffusion.
D.G.Holloway

539.2

7977 THE DIFFUSION OF ANTHRACENE-9-C-14 IN SINGLE CRYSTALS OF ANTHRACENE.
Sherwood and S.J.Thomson.
Trans Faraday Soc., Vol. 56, Pt 10, 1443-57 (Oct., 1960)..

Studies have been made of the diffusion of C^{14} labelled anthracene into single crystals of anthracene from the (001) plane, between 150° and 190° C under a pressure of 16 atm of nitrogen to minimize evaporation losses. Two diffusion processes were detected, one fast, the other slow. The latter could be described in terms of the equation, $D = 6.5 \times 10^{10} \exp (42\,400 \pm 1200/RT)\ cm^2/sec$, where the activation energy is in cal/mole. The slow diffusion has been interpreted in terms of vacancy diffusion, in a lattice in which there is a degree of loosening.

539.2

17978 RADIATION-INDUCED PRECIPITATION SITES IN POTASSIUM CHLORIDE. S.Amelinckx.
Acta metallurgica, Vol. 7, No. 9, 650-1 (Sept., 1959).

It has been suggested that possible nucleation sites exist in a quenched supersaturated solid solution other than dislocations or grain boundaries. There is some evidence that small prismatic dislocation loops resulting from vacancy condensation might act as such. X-irradiation may also create nucleation centres. A KCl single crystal doped with 0.4 wt% $AgNO_3$ can be decorated by X-irradiating for 4 hr followed by annealing in air for 1 hr at 600°C. The decoration is due to the formation of small cubic cavities whose walls are covered by Ag, and which are filled with gas under pressure from the NO_3 group decomposition on annealing. Decoration was also achieved by hydrogen treatment at the same temperature. It is suggested that the apparently randomly distributed precipitates are formed at the clusters of vacancies. The majority of precipitates form plate-like cavities in the cubic plane.
R.V.Coates

539.2 : 539.17

17979 STUDY OF IRRADIATION EFFECTS AND THE $H^2 + H^2$ BUILDUP IN TANTALUM.
A.F.Gabrysh, H.Eyring, M.E.Wadsworth, G.S.Baker and T.Ree.
J. appl. Phys., Vol. 31, No. 10, 1785-91 (Oct., 1960).

The irradiation effects and the increase of neutron yield from the deuterium—deuterium reaction in tantalum has been studied at a bombarding energy of 350 keV and a target current 100 μA saturation (the neutron yield becomes a steady maximum) is reached in a new target, maintained at temperatures below 45°C, after about 2 hours of steady bombardment or on the order of 1 coulomb of deuterons per square centimetre. The irradiated targets were annealed at temperatures from 45°C to 770°C. A thermal analysis shows that a prominent exothermic maximum in the annealing spectrum occurs at approximately 612° C. This maximum is associated with an increase in pressure, indicating an abrupt increase in diffusion of deuterium from the target at this temperature. From a study of diffusion of deuterium from the specimen at three temperatures, an activation energy of 0.24 eV is calculated for diffusion of deuterium in tantaium. X-ray traces were taken of the specimen before and after bombardment and after annealing. These showed an expansion of the lattice together with changes in line intensities indicating a distortion in the lattice structure.

539.2

17980 ELECTRON-MICROSCOPIC OBSERVATIONS ON RADIATION DAMAGE IN GRAPHITE. W.Bollmann.
Phil. Mag. (Eighth Ser.), Vol. 5, 621-4 (June, 1960).

Transmission electron microscopy has been applied to the study of lattice defects introduced by neutron irradiation of graphite. The dark-field technique has proved to be especially useful for this purpose. The technique of preparation is described and a tentative interpretation of the observations is given.

ELECTRICAL PROPERTIES OF SOLIDS

(Superconductivity is included under Low-Temperature Physics)

539.2 : 537.3

17981 ELECTRICAL CONDUCTIVITY OF SOLID SUBSTANCES WITH IONIC-ATOMIC VALENCY. IX. DEGREE OF DISSOCIATION AND CATION MOBILITY IN GLASSES WITH IONS OF THE SAME TYPE. R.L.Myuller.
Fiz. tverdogo Tela, Vol. 2, No. 6, 1333-8 (June, 1960). In Russian.

For Pt VIII, see Abstr. 9168 of 1957. A theoretical proof is given for the possibility of calculation of the mobility factor w_0 in a glass containing ions of one type only, this factor being virtually independent of the chemical composition of the glass and having only a very small temperature coefficient. The degree of dissociation of ions in the glass is determined by the magnitude ψ_f which is numerically close to the energy of dissociation of ions in the glass; this magnitude decreases as the content of polar nodes in the glass increases. It is deduced that the cation mobility mechanism remains the same in glasses, whether in the solid or melted state.

F.Lachman

539.2 : 537.3

17982 EFFECT OF RANDOM INHOMOGENEITIES ON ELECTRICAL AND GALVANOMAGNETIC MEASUREMENTS. C.Herring.

J. appl. Phys., Vol. 31, No. 11, 1939-53 (Nov., 1960).

This paper is designed to supplement the existing extensive literature on the conductivity of a randomly inhomogeneous medium, by treating the effects of inhomogeneities on piezoelectric, galvanomagnetic, and thermoelectric measurements. The scale of the inhomogeneities is supposed small compared with the dimensions of the specimen being measured, but large compared with mean free path, Debye length, etc. Formulae for all the effects are derived which are asymptotically exact in the limits of small fractional fluctuations in the local conductivity, etc. Comparison with other approximations and application to various exactly soluble cases show that these formulas are often roughly valid for quite sizable fluctuations. For material which, if uniform, would show a high field saturation of transverse magnetoresistance, the presence of appreciable inhomogeneities in the Hall constant will cause the magnetoresistance to increase indefinitely with field. This effect is due to the current distortions arising from the large and fluctuating Hall fields. For the special case of an isolated inclusion, these distortions are shown to extend, at high fields, to distances in the direction of the magnetic field which are many times the diameter of the inclusion. Under some conditions it appears that even the random distribution of impurities in a semiconductor can give rise to perceptible fluctuations on a scale large enough for concepts of macroscopic conduction to be applicable. Since fluctuations of even smaller scale are still larger, the total effect of fluctuations cannot be properly treated by the present methods; however, when the macroscopic part of the fluctuations is large, conventional impurity-scattering theories must be inadequate. Applications to polycrystalline metals and semiconductors are discussed briefly.

539.2 : 537.3

17983 EVIDENCE FOR A CONFIGURATIONAL E.M.F. IN A CONDUCTING MEDIUM. M.Chester.

Phys. Rev. Letters, Vol. 5, No. 3, 91-3 (Aug. 1, 1960).

By analogy with the hydrodynamics of flow of a liquid through a constriction it is argued that the flow of conduction electrons through a solid should speed up at a constriction, and energy conservation demands an extra e.m.f. to be developed in the system. Experiments on thin Bi films indicate that this e.m.f. exists but numerical agreement with a simple theory is poor. C.A.Hogarth

539.2 : 537.3

17984 THE EFFECT OF SOLUTE PRECIPITATION ON THE RESISTIVITY OF ALLOYS. W.A.Harrison.

Acta metallurgica, Vol. 8, No. 3, 168-71 (March, 1960).

The effect of clustering upon the residual resistivity of alloys is treated using a free-electron model. The effects of lattice strain are taken into account as a change in the effective valence of the solute.

539.2 : 537.3

17985 THEORY OF IMPURITY RESISTANCE IN METALS. J.S.Langer.

Phys. Rev., Vol. 120, No. 3, 714-25 (Nov. 1, 1960).

A many-body technique is developed for the calculation of the d.c. resistivity of a Fermi fluid in the presence of a few, randomly scattered, fixed, impurities. A certain class of graphs yields an expression for the conductivity which is similar in form to the standard classical transport coefficient; but the decay time is determined by the scattering of single-particle-like excitations at the Fermi surface by screened impurities. A propagator method similar to that used in field theory is employed throughout, and the perturbation-theoretic interpretation of this method is examined in some detail.

539.2 : 5

17986 INFLUENCE OF ORDER ON THE ELECTRICAL RESISTANCE OF BINARY ALLOYS. A.Corciovei.

Rev. de Physique (Bucarest), Vol. 4, No. 4, 381-96 (1959). In Fr

Theoretical, using perturbation theory. The unperturbed Hamiltonian is that of a perfectly ordered binary alloy. The perturbing terms include disorder and lattice vibrations. It is found that the total resistivity is not exactly the sum of the two terms Mathiessen's equations. Some simplifying hypotheses are discus as well as the behaviour of the resistivity at low temperature.

L.Pinche

539.2 : 5

17987 EFFECT OF ORDER ON THE ELECTRICAL RESISTANCE OF BINARY ALLOYS. A.Corciovei.

Stud. Cercetari Fiz., Vol. 10, No. 1, 117-31 (1959). In Roumania

Theoretical. Alloys are considered in which the concentrati of the two components is approximately equal and the order almo complete. The potential used is different from Nordheim's, in order to eliminate some defects of the latter. The Mathiessen ru is discussed and it is shown that Kohler's inequality (Abstr. 8732 1950) is preferable. Some effects at low temperature and near t Curie point are discussed qualitatively. L.Pinche

539.2 :

17988 THEORY OF MAGNETORESISTANCE. I. J.Hajdu.

Z. Phys., Vol. 160, No. 1, 47-58 (1960). In German.

Current theory (in the absence of "quantum effects") is refin The relaxation time is determined by means of a variational procedure, and by calculation of average values of the transition probabilities in typical cases. L.Pinch

539.2 : 5

17989 THE THEORY OF PIEZORESISTANCE IN Bi_2Te_3. M.I.Klinger.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1353-6 (June, 1960). In Russia

It is shown how the deformation potentials and the orientatio of the conduction band ellipsoids may be calculated from the resu of piezoresistance measurements. M.G.Pries

539.2 : 53

17990 MEASUREMENT OF THE HALL EFFECT IN POWDERED MATERIALS. P.Bothorel.

C.R. Acad. Sci (Paris), Vol. 250, No. 25, 4120-2 (June 20, 1960). In French.

Measurements of the Hall effect in powdered materials (carb subjected to pressures up to 1 metric ton per cm^2 have been mad using a previously described apparatus (Abstr. 9946 of 1960). It shown that a Hall constant can be obtained which is independent the pressure and is characteristic of the material. S.A.Ah

539.2 : 53

17991 ANOMALOUS HALL EFFECT DUE TO AN s—d INTE ACTION IN THE DILUTE ALLOYS CONTAINING THE TRANSITION ELEMENTS. M.Tsuji.

J. Phys. Soc. Japan, Vol. 14, No. 5, 686 (May, 1959).

From Yosida's theory of anomalous negative magnetoresista (Abstr. 607 of 1058), an anomalous Hall coefficient ΔR_H is predi for noble metals with traces of transition elements. Schmitt and Jacobs's measurements of magnetoresistance of 0.2 at.% Mn in C [(J. Phys. Chem. Solids, Vol. 3, 324 (1957)] are used in the calcul tion of $\Delta R_H/R_H$ as a function of field and temperature; it is of the order of 1% at 4^0 K and $5 \times 10^7 (Oe)^2$. F.Ansbach

539.2 : 5

17992 HALL CONSTANT AND DEPENDENCE ON MAGNET FIELD OF THE ELECTRICAL CONDUCTIVITY OF THIN METALLIC LAYERS WITH DUAL CONDUCTIVITY. N.Kroitoru and G.Chobanu.

Rev. de Physique (Bucarest) Vol. 5, No. 1, 133-42 (1960). In Rus

Formulae for the Hall constant and electrical conductivity in magnetic field are derived from the Boltzmann transport equatio for the case when both electrons and holes are present. Some special cases are considered and the results reduce to those of Sondheimer when only one type of charge carrier is considered.

D.J.Hunt

539.2 : 53

17993 SOME REMARKS ON THE GYULAI—HARTLY PRESS EFFECT. J.Boros.

Acta phys. Hungar., Vol. 8, No. 1-2, 83-8 (1957). In German.

Sudden compression of NaCl and other alkali halide crystals ud a temporary increase in the electrical conductivity, which u be more than 10 times the original conductivity for a pressure g/cm^2. Changes of over 20 times were obtained with crystals nining F- and U-centres. The conductivity decreased to the nal value in about 5 min.

J.Franks

539.2 : 537.3

7994 ANOMALOUS INCREASE OF RESISTIVITY DURING AGEING OF ALUMINIUM—SILVER ALLOYS.

derighi and L.Passari.

metallurgica, Vol. 7, No. 6, 422-4 (June, 1959).

The data show that in general on ageing the resistivity first eases and then falls rapidly. The maximum is attributed to the clustering of solute atoms, and the subsequent decrease to ncrease in size of the clusters and the loss of quenched-in ncies. It was observed that the time to reach the maximum d be reduced by increasing either the annealing temperature or uenching temperature. The effect is observed even in alloys aining 8.1% Ag provided either the annealing or quenching erature is lowered sufficiently. Al—Zn 10.25% alloys also bit the effect, but preliminary experiments with Al—Si alloys 1.3%) have not shown this behaviour, so it is tentatively med that a pre-precipitation phenomenon does not occur in this em.

A.E.Kay

539.2 : 537.3

7995 ON THE ELECTRICAL CONDUCTIVITY OF HARD CARBIDES AND CARBIDE MIXED CRYSTALS AT HIGH TING POINT.

E.Rudy and F.Benesovsky.

seeber. für Pulvermetall., Vol. 8, No. 2, 72-82 (Aug., 1960). erman.

Reports measurements by eddy current methods. The values ined are lower than those given so far in the literature. In some do-binary systems, maxima of the resistivity are observed at ain compositions.

L.Pincherle

539.2 : 537.3

17996 EFFECTS OF INTERNAL OXIDATION AND HEAT TREATMENT ON THE ELECTRICAL RESISTIVITY DILUTE CuMn, CuFe, AND CuCo ALLOYS.

.Domenicali and E.L.Christenson.

ppl. Phys., Vol. 31, No. 10, 1730-3 (Oct., 1960).

This investigation was concerned with the effects of high tem- rature treatment in vacuo or in rarefied oxygen atmospheres upon effective electrical resistivity of dilute (copper-rich) CuMn, Fe, and CuCo rods and wires. The CuMn alloys studied most ensively contained between 1 and 12 at.% manganese while the Fe and CuCo alloys contained between 0.1 and 0.3 at.% iron or alt. It was found that the solutes in the CuFe and CuCo wires rods become rapidly oxidized (internally) during heat treatment several hours at 990° C in pure oxygen pressures of 0.5 μ or eater, while in 0.05 μ O_2 this oxidation is absent and previously dized specimens are reduced. These observations are based on asurements of electrical resistivity, and in the case of CuFe, stantiated by measurements on the magnetiziation. Heat treat- nt of these CuFe and CuCo wires and rods near 1000° C for veral hours either in vacuo (0.1 μ air) or 5 μ O_2 does not appre- bly affect the cross-sectional uniformity of these specimens. the case of CuFe alloys, the magnetic behaviour demonstrates virtually complete oxidation of solute to Fe_3O_4 after prolonged neal in an oxidizing atmosphere. The behaviour of the CuMn oys was found to be more complicated, partly because of the high lute concentrations involved. It was found that wires and rods of Mn rapidly become nonuniform in solute concentration throughout eir cross-section when annealed near 1000° C for several hours her in a vacuum (0.1 μ air) or in 5 μ of pure oxygen; this non- iformity of manganese concentration develops at a considerably gher rate in the 5 μ O_2 atmosphere than in vacuum, and leads to róneous values of the resistivity and to erroneous curves of sistivity versus temperature for CuMn wires or rods. On the er hand annealing of such wires for several hours in vacuum at mperatures around 800° C does not appreciably disturb the cross- ctional uniformity. Finally, it is emphasized that the "carrier s" technique (involving a flow system with small concentrations oxygen mixed with helium at atmospheric pressure, for example) entirely unsatisfactory for experiments on internal oxidation, rticularly if one wants to know the oxygen partial pressure.

539.2 : 537.3

17997 THE RESISTIVITY OF ORDERED Au_3Cu.

B.M.Korevaar.

Physica, Vol. 25, No. 10, 1021-32 (Oct., 1959).

The influence of order on the resistivity of Au_3Cu was measured at −195° C. Long-range order is formed in Au_3Cu below 200° ± 3° C. Above this temperature only short-range order can appear. Short-range order causes an increase in the resistivity; long-range order a decrease. Complete ordering at 80° C decreases the resistivity measured at −195° C to 40% of the initial value. It appears to be impossible to suppress completely the information of short-range order by the quenching process used in this investigation. The ordering processes in Au_3Cu are qualitatively equal to those in Cu_3Au.

539.2 : 537.3

17998 EFFECT OF CHEMICAL TREATMENT ON THE ELECTRICAL CONDUCTIVITY OF GRAPHITE.

R.Bhattacharyya.

Indian J. Phys., Vol. 33, No. 9, 407-9 (Sept., 1959).

The usual purifying treatments for graphite cause an easily detectable enhancement of the small amount of misalignment originally present between the basal planes of the different crystal blocks. The effect of such treatments on the electrical conductivity of graphite is investigated and a decreased conductivity along the basal plane and an increased conductivity along the c-axis are observed. These data suggest that previously-published electrical measurements on treated graphite samples may be in error.

C.A.Hogarth

539.2 : 537.3

17999 THE ELECTRICAL RESISTANCE MAXIMUM IN DILUTE MAGNESIUM ALLOYS.

G.Gaudet, F.T.Hedgcock, G.Lamarche and E.W.Wallingford.

Canad. J. Phys., Vol. 38, No. 8, 1134-5 (Aug., 1960).

Mg—Mn alloys, with Mn atomic percentages between 0.16 and 0.60 show a maximum in their electrical resistance at a temperature T_M between 1.2 and 6.7° K. T_M increases with increasing Mn content. The maximum is followed by a minimum, at temperatures between 21 and 33° K, the amplitude of the "swing" decreasing with increasing impurity content. In the region of the maximum the magnetoresistance is negative. Results are consistent with the formation of solid solutions.

L.Pincherle

539.2 : 537.3

18000 TEMPERATURE DEPENDENCE OF THE VARIATION OF THE ELECTRICAL RESISTANCE OF MAGNETITE MONOCRYSTALS IN A MAGNETIC FIELD AT LOW TEMPERATURES.

T.D.Zotov.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 1, 48-52 (Jan., 1960). In Russian.

Magnetite single crystals, previously subjected to cooling below the low-temperature transformation in transverse or longitudinal magnetic fields, were studied in the range 78-213° K. The resistivity measurements were made with the temperature increasing at 2 deg C/hr in a field of 20 000 Oe. All the curves of relative change of resistance (ΔR/R) versus temperature have two minima at 111.5° and 95° K, which is attributed to the preferential scattering of the conduction electrons.

539.2 : 537.3

18001 ELECTRICAL CONDUCTIVITY OF SOME PALLADIUM SULFIDES AND OF SILVER PALLADIUM SULFIDE.

H.Fischmeister.

Acta chem. Scand., Vol. 13, No. 4, 852-3 (1959).

The following values were recorded:

Compound	$\rho_{20°C}$ (Ωcm)	dρ/dt (Ωcm/deg C)
Pd_4S	3.20×10^{-4}	$+1.05 \times 10^{-6}$
$Pd_{2.2}S$	10.00×10^{-4}	$+1.80 \times 10^{-6}$
Ag_2Pd_3S	1.93×10^{-4}	$+0.22 \times 10^{-6}$

ρ is quoted without correction for porosity, which was ~ 10%.

539.2 : 537.3

18002 ELECTRICAL RESISTIVITY OF THE HEAVY RARE-EARTH METALS.

R.V.Colvin, S.Legvold and F.H.Spedding.

Phys. Rev., Vol. 120, No. 3, 741-5 (Nov. 1, 1960).

The electrical resistivities of polycrystalline Gd, Tb, Dy, Ho, Er, Tm, and Lu were measured between 1.3°K and room temperature. The slope of the resistivity curve for Gd changes near the Curie point. The curve for Tb is very much like that for Gd but there is some evidence that two ordering temperatures exist for this metal. Dy, Ho, and Tm all show peaks in resistivity near their Néel points, while Er shows only a change in slope at its Néel point. The change from ferromagnetism to antiferromagnetism in Dy is seen as a sharp rise in the resistivity.

539.2 : 537.3 : 530.16

THE ELECTRICAL PROPERTIES OF ICE. See Abstr. 16652

Semiconductors

539.2 : 537.311

18003 A COMPARATIVE STUDY OF THE MAGNETORESISTANCE AND PHOTOELECTRIC METHODS OF MEASURING THE RATES OF SURFACE RECOMBINATION. O.V.Sorokin and B.T.Tuseev.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1533-5 (July, 1960). In Russian.

The changes in the rate of surface recombination in n-type Ge, taking place on the application and removal of an external magnetic field, were measured by three different methods (the constant component of the potential of the magnetoresistance effect, the potential of the second harmonic of the magnetoresistance effect, and the "scanning light beam" method). The results indicated that the magnetoresistance method gives correct results even when the concentration of the surface recombination centres and the magnitude of the surface electrostatic potential vary. M.H.Sloboda

539.2 : 537.311

18004 A NOTE ON THE MOOSER—PEARSON LAW. E.L.Zorina.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1936 (Aug., 1960). In Russian.

It is shown that the law of octets, used by Mooser and Pearson as a criterion of semiconductivity, holds also for the compounds formed by the elements of the IV-VII groups if the symbols in the formula $n_v/n_a + b = 8$ are made to denote the total number of the valency electrons and electrons pairs on the anions (n_v), the number of anions (n_a), and the number of bonds formed by the anions (b). M.H.Sloboda

539.2 : 537.311

18005 STATISTICS OF THE OCCUPATION OF DISLOCATION ACCEPTORS (ONE-DIMENSIONAL INTERACTION STATISTICS). R.M.Broudy and J.W.McClure.

J. appl. Phys., Vol. 31, No. 9, 1511-16 (Sept., 1960).

It is known that dislocations in semiconductors can act as acceptors. This effect has been explained by noting that dislocations with edge components can have unpaired electrons at the terminating half-plane which act as acceptors; thus a dislocation contains a line of uniformly spaced acceptors only a few angstroms apart. In n-type materials the dislocation line becomes negatively charged and a positive space charge develops around the line. The occupation statistics are strongly modified by the electrostatic energies involved. Certain approximate solutions to this problem have already been given by Read (Abstr. 9554 of 1954; 1351 of 1955). This paper derives improved statistics which, in addition, explicity take into account interactions between nearest-neighbour electrons; the results are valid over the complete range of occupation. The statistics are given in terms of two functions which occur in the form of infinite series; the series have been evaluated over a considerable range of occupation and are herein tabulated. Techniques for use of the results are presented. The theory was applied to a specific problem originally chose by Read. The results fall between his most accurate approximations for this problem. Statistics have also been derived which take into account the proper spin degeneracy of acceptor states.

539.2 : 537.311 : 621.382

18006 SURFACE SPACE-CHARGE CALCULATIONS FOR SEMICONDUCTORS. D.R.Frankl.

J. appl. Phys., Vol. 31, No. 10, 1752-4 (Oct., 1960).

Approximation formulae for the surface excesses of carriers at large values of the reduced surface and bulk potentials are derived, and computed results are presented.

539.2 : 537

18007 HALL FIELD RELAXATION IN SEMICONDUCTORS AT HIGH FREQUENCY. K.S.Champlin.

J. appl. Phys., Vol. 31, No. 10, 1770-71 (Oct., 1960).

Using a simple extension of standard magneto-ionic theory, the frequency dependence of the complex Hall field is calculated for samples with rectangular, cylindrical, and spherical geomet The result has application to "open-circuit" Hall effect measurements on semiconductors at microwave frequencies.

539.2 : 537

18008 ANALYSIS OF THE EFFECTS OF MULTIPLY-CHA IMPURITIES IN SEMICONDUCTORS BY THE MASS ACTION LAW. N.H.Saunders.

J. Electronics and Control, Vol. 8, No. 2, 91-6 (Feb., 1960).

The mass action law is used to derive expressions for the equilibrium carrier concentration and net steady-state recombi rate in a semiconductor containing impurities capable of being multiply-ionized. The results are in agreement with those found by other treatments and can easily be modified to apply to the degenerate case.

539.2 : 537.

18009 VARIATIONAL TREATMENT OF WARM ELECTRO IN NONPOLAR CRYSTALS. I.Adawi.

Phys. Rev., Vol. 120, No. 1, 118-27 (Oct. 1, 1960).

For previous work, see Abstr. 1624 of 1960. Deviations fro Ohm's law in nonpolar crystals are treated for weak fields by the variational method. A simple band structure is assumed. Scatte ing by both acoustical and optical phonons, and ionized impurities included. It is shown that the influence of optical phonons on the field dependent mobility (E^2 term where E is the electrostatic fie is maximum for a temperature which corresponds approximately the optical phonon energy. The field dependent mobility is highly sensitive to ionized impurity scattering, as in the case of acousti phonons alone. Finally, the convergence of the variational metho is established in limiting cases using as a representation a set of polynomials which are orthonormal with respect to the collision operator. Extensive calculations are given for electrons in germanium and comparison with experiment is discussed.

539.2 : 537.3

18010 FREE CARRIER ABSORPTION DUE TO POLAR MOD IN THE III—V COMPOUND SEMICONDUCTORS. S.Visvanathan.

Phys. Rev., Vol. 120, No. 2, 376-8 (Oct. 15, 1960).

The longitudinal polar modes of vibration in the III—V compound semiconductors play an important part in determining thei transport properties, such as mobility. One would therefore expect them to be important for free carrier absorption, as well, in these semiconductors. A quantum mechanical calculation of the free carrier absorption arising from these modes has been made and gives an absorption varying as $\lambda^{2.5}$; such behaviour has been reported experimentally in InP and GaP. The calculated value of the absorption coefficient in InP is in good agreement wi experiment.

539.2 : 537.

18011 FREE CARRIER ABSORPTION ARISING FROM IMPURITIES IN SEMICONDUCTORS. S.Visvanathan.

Phys. Rev., Vol. 120, No. 2, 379-80 (Oct. 15, 1960).

The free carrier absorption due to ionized impurities in semiconductors is essentially the inverse process of bremsstrahlung. The cross-section for bremsstrahlung is readily available in the literature and one can calculate the spectral distribution of bremsstrahlung for the carriers in a semiconducto furthermore, by using Kirchhoff's law of radiation, relating the emission and absorption in the semiconductor, one arrives quite easily at the absorption coefficient. The results so obtained agre with those of previous authors who have used a different method o calculation. The inadequacy of the Born approximation in the calculation of the ionized impurity effects on free carrier absorpt is brought out clearly in the present treatment.

539.2 : 537.3

18012 THEORY OF THE ETTINGSHAUSEN EFFECT IN SEMICONDUCTORS. B.V.Paranjape and J.S.Levinge

Phys. Rev., Vol. 120, No. 2, 437-41 (Oct. 15, 1960).

The Ettingshausen effect in semiconductors is mainly due to the generation of electron-hole pairs at one side of the sample and their recombination at the other side. The Ettingshausen ient is calculated, in agreement with Putley, as

$$P = (E_g/\kappa ec)z(1 + z)^{-2}(\mu_e + \mu_h)$$

r $z = (n_h\mu_h/n_e\mu_e)$, the ratio of hole conductivity to electron tivity. E_g is the gap energy, and κ the thermal conductivity. rmulae is discussed for intrinsic, p-type and n-type semi- tors. P goes through a maximum for p-type semiconductors e temperature at which the Hall voltage goes through zero. results agree reasonably well with the measurements of Gärtner, and Loscoe of P as a function of temperature for nt samples of germanium and silicon.

539.2 : 537.311

13 IMPURITY CONDUCTION AT LOW CONCENTRATIONS. A.Miller and E.Abrahams.

Rev., Vol. 120, No. 3, 745-55 (Nov. 1, 1960).

he conductivity of an n-type semiconductor has been calculated region of low-temperature T and low impurity concentration he model is that of phonon-induced electron hopping from donor donor site where a faction K of the sites is vacant due to nsation. To first order in the electric field, the solution to the -state and current equations is shown to be equivalent to the on of a linear resistance network. The network resistance is ted and the result shows that the T dependence of the resistivity exp(ϵ_3/kT). For small K,

$$\epsilon_3 = (e^2/\kappa_0)\,(4\pi n_D/3)^{1/3}(1 - 1.35K^{1/3}),$$

κ_0 is the dielectric constant. At higher K, ϵ_3 and ρ attain a num near K = 0.5. The dependence on n_D is extracted; the ment of the latter and of ϵ_3 with experiment is satisfactory. agnitude of ρ is in fair agreement with experiment. The nce of excited donor states on ρ is discussed.

539.2 : 537.311

014 DETERMINATION OF THE EFFECTIVE MASS OF CURRENT CARRIERS IN SEMICONDUCTORS FROM ARED ABSORPTION. K.J.Planker and E.Kauer.

gew. Phys., Vol. 12, No. 9, 425-32 (Sept., 1960). In German.

arious theories of infrared absorption in semiconductors are ared with one another and with experiment. Derivations are ly omitted, and only final results are quoted.

P.T.Landsberg

539.2 : 537.311 : 536.3

015 SEMICONDUCTORS AND INFRA-RED SPECTROSCOPY. R.A.Smith.

a Acta, Vol. 7, No. 2, 137-57 (April, 1960).

he use of semiconductors to provide extremely sensitive and infrared detectors is discussed; in particular, recent work on detectors for the spectral region 3μ - 5.5μ is decribed and the extension of photoelectric detection to 135μ using german- doped with antimony. The use of such detectors has led to an nsion of infrared techniques which in turn has led to some le advances in the knowledge of the fundamental properties of conductors. A number of the more recent advances based on red absorption and emission spectroscopy using single crystals discussed.

539.2 : 537.311

016 IN-PILE HALL COEFFICIENT MEASUREMENTS OF GERMANIUM BOMBARDED BY FAST NEUTRONS.

uras and J.Suwalski.

phys. Polon., Vol. 19, No. 1, 115-18 (1960).

Assuming no change in mobility and scattering by bombardment -type germanium with fast neutrons the Hall coefficient was ulated on the basis of 2 and 3 carrier models. Good agreement experiment was only obtained on the basis of the 3 carrier model, ight holes and a ratio of mobility of light holes to ordinary holes .5, confirming the results of Walton and Moos (Abstr. 12307 of).

G.C.Williams

539.2 : 537.311

8017 DRIFT MOBILITY IN NEUTRON IRRADIATED N-TYPE GERMANIUM. W.H.Closser.

ppl. Phys., Vol. 31, No. 9, 1693 (Sept., 1960).

Experimental evidence is presented of a 25% increase in drift ility μ (to about 2400 $cm^2V^{-1}sec^{-1}$) as the fast neutron diation is increased to about 10^{12} followed by a steep decline further irradiation. Only the decline is found with 2 MeV electron irradiation. The increase in μ is consistent with the assistance given to the propagation of a minority carrier pulse by the islands of p-type material produced by the fast neutron damage. The decrease in μ for higher irradiations of both kinds is interpreted as due to point defects.

F.F.Roberts

539.2 : 537.311

18018 INVESTIGATIONS ON THE LIFETIME OF MINORITY CARRIERS IN GERMANIUM. T.Stubb.

Acta polytech. Scand. Ph. 3 (269/1960) 16 pp. = State Inst. Tech. Res. Finland No. 49. In German.

The light-pulse method of Stevenson and Keyes (Abstr. 2745 of 1955) is used to measure the surface recombination velocity S of germanium specimens etched in various solutions. A surface etched in a solution containing $AgNO_3$ (Westinghouse silver etch) gave the lowest value of S.

G.C.Williams

539.2 : 537.311

18019 THE MECHANISM OF CARRIER SCATTERING IN P-TYPE GERMANIUM.

M.N.Vinogradova, O.A.Golikova, B.P.Mitrenin and L.S.Stil'bans.

Fiz. tverdovo Tela, Vol. 2, No. 7, 1428-30 (July, 1960). In Russian.

The hole mobility μ in 5 specimens of Ge with impurity concentration $2.8 - 80 \times 10^{15}$ cm^{-3} was measured in the temperature range 100-450°K. From the independence on temperature of the differences in $1/\mu$ it was deduced that ion scattering was proportional to the first power of the velocity. The law $u \propto T^{-2.3}$ was confirmed for phonon scattering.

D.J.Huntley

539.2 : 537.311

18020 THE INFLUENCE OF LINEAR DISLOCATIONS ON THE RECOMBINATION OF CHARGE CARRIERS IN HOLE—CONDUCTIVITY TYPE GERMANIUM. M.I.Iglitsyn and L.I.Kolesnik.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1542-4 (July, 1960). In Russian.

Polycrystalline Ge (allowed with Ga to give 3 and 29 ohm material) was deformed plastically in vacuo (10^{-4} mm Hg) at 700°C. The initial dislocation density was $< 10^3$ cm^{-2} and after deformation 10^5 to 10^6 cm^{-2}, determined by etching on a (111) plane. The life-time of minority carriers was measured between −70° and +60°C. For both specimens $\tau = AN_D{}^{-1}$, where A is the inverse of the recombination coefficient per unit length of dislocation σ_R. For the 3 ohm cm specimen A = 3 cm^2/sec, and for 30 ohm cm A = 18 cm^2/sec. The relation shows that each dislocation acts as a recombination centre. When the τ versus 1/T curve is corrected for the temperature variation of σ_R $(T^{-2.2})$, $\log(\tau T^{-2.2})$ versus 1/T has a straight part corresponding to an activation energy of 0.14 eV. The cause of the disagreement with the value 0.22 eV from the effect of plastic deformation of the Hall effect at helium temperatures. (Abstr. 8621 of 1957) requires further study.

R.Berman

539.2 : 537.311

18021 A STUDY OF THE KINETICS OF FAST SURFACE STATES OF GERMANIUM.

V.G.Litovchenko and V.I.Lyashenko.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1592-6 (July, 1960). In Russian.

The following relations were measured at various temperatures, both in the dark and under low constant illumination on n- and p-type Ge (20-55 ohm cm): (1) the dependence of field effect $\tau_{f.e.}$ and photoconductivity τ_p on temperature; (2) dependence of $\tau_{f.e.}$ on constant transverse field V, and the dependence of surface conductivity on V, $\Delta\sigma_S(V)$; (3) $\Delta\sigma_1(V)$ and $\Delta\sigma_2(V)$ where $\Delta\sigma_1$ and $\Delta\sigma_2$ are the initial and stationary changes in σ_S; (4) $\tau_p(V)$ and $\tau_{p,\,quasi\ stat.}(V)$. The results are presented graphically.

R.Berman

539.2 : 537.311

18022 ELECTRICAL CONDUCTIVITY AND HALL EFFECT OF Ge—Si ALLOYS. G.Busch and O.Vogt.

Helv. phys. Acta, Vol. 33, No. 5, 437-56 (1960). In German.

The preparation of Ge—Si single-crystalline or coarsely polycrystalline alloys is described. The composition of the samples is determined by measurements of densities and lattice constants. Hall constants and electrical conductivities were measured as functions of temperature between 20° and 900°C. Mobilities for electrons and holes and intrinsic carrier concentrations are calculated as functions of the alloy composition.

539.2 : 537.311

18023 ELECTRICAL PROPERTIES OF VAPOR-GROWN Ge JUNCTIONS.

M.J.O'Rourke, J.C.Marinace, R.L.Anderson and W.H.White.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 256-63 (July, 1960).

A method of fabricating p—n junctions and p—n junction devices by a closed-cycle iodide vapour-growth process is described. The electrical characteristics of junctions made by alternately depositing p-type and n-type germanium onto a germanium substrate compare favourably with those fabricated by other means. Device arrays, such as diode matrices, and multijunction structures have been made by this process. If sufficient control can be achieved, devices having a wide range of impurity distributions and geometric configurations will be possible.

539.2 : 537.311

18024 A VAPOR-GROWN VARIABLE CAPACITANCE DIODE.

R.L.Anderson and M.J.O'Rourke.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 264-8 (July, 1960).

Germanium p—n junctions have been made which have a large fractional variation of capacitance with voltage and which have promise of being operable at high frequencies. These diodes were produced by a vapour-growth process in which the doping was switched from n-type to p-type during growth. Capacitances which vary as the reciprocal of voltage over a considerable range have been observed. This capacitance variation corresponds to a net donor concentration which decreases from its value at the junction approximately as the reciprocal of distance from the junction. At a position corresponding roughly to the edge of the transition region at breakdown, the net donor concentration abruptly increases. This rapid variation of capacitance with voltage and the low series resistance resulting from the discontinuity in doping level should result in high-frequency diodes, if the magnitude of the discontinuity can be increased sufficiently.

539.2 : 537.311

18025 TUNNEL DIODES BY VAPOR GROWTH OF Ge ON Ge AND ON GaAs.

J.C.Marinace.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 280-2 (July, 1960).

Degenerate n-type Ge can be vapour-grown epitaxially on degenerate p-type Ge or GaAs. In either case tunnel diodes are made. Subsequent heat treatment can increase the peak current density. Details are given of the electrical characteristics of the diodes at room temperature, 77°K and 4°K. C.Hilsum

539.2 : 537.311

18026 GERMANIUM—GALLIUM ARSENIDE HETERO-JUNCTIONS.

R.L.Anderson.

I.B.M. J. Res. Developm., Vol. 4, No. 3, 283-7 (July, 1960).

A vapour growth technique was used to deposit n-type Ge on p-type and n-type GaAs. In both cases a rectifying junction was made, with the transition region mainly in the GaAs. The rectification was of opposite polarity for the two types of junction. The electrical characteristics of the junctions were measured, and the experimental results were in good agreement with the theory developed in the paper. C.Hilsum

539.2 : 537.311

18027 OSCILLATIONS IN GERMANIUM WITH AN APPLIED PULSED ELECTRIC FIELD.

M.Cardona and W.Ruppel.

J. appl. Phys., Vol. 31, No. 10, 1826-7 (Oct., 1960).

Filaments of p-type Ge 8 × 4 × 2 mm were etched in CP4. A tin contact was soldered on to one end and a metal point contact placed on the other end. When a forward voltage greater than 30 V was applied to the point contact current oscillations were observed. The oscillations were of two types, one with a frequency near 5 kc/s and a modulation depth of 10%, and the other near 5 Mc/s with modulation up to 60%. The oscillations were not affected by a longitudinal magnetic field of up to 10 000 G, but disappeared or were strongly distorted in a transverse magnetic field. C.Hilsum

539.2 : 537.311

18028 THE TEMPERATURE DEPENDENCE OF THE POLARIZABILITY OF THE FREE CARRIERS IN GERMANIUM AND SILICON.

M.Cardona, W.Paul and H.Brooks.

Helv. phys. Acta, Vol. 33, No. 5, 329-46 (1960).

The reflectivity of n- and p-type Ge and Si at doping levels above 10^{18} carriers/cm^3 has been measured at 297° and 90°K at wavelengths from 2 to 20 μ. The contribution of the free carriers to the total electric polarizability was determined from the reflectivity, and hence an average effective mass for the carriers was deduced. An increase in electron mass with both carrier concentration and temperature was found in both n-type Ge and n-type Si. If both effects are assumed to originate from the non-parabolic character of the conduction band, then the effect of carrier concentration is too large compared with the effect of temperature, and both effects are too large to be compatible with estimates of the band gap at zone boundary. No definite conclusions can be drawn about p-ty Ge owing to transitions between branches of the degenerate vale band. For p-type Si the effective mass increases with temperat

539.2 : 537.311 : 621.382

18029 FAST NEUTRON BOMBARDMENT OF GERMANIUM AND SILICON ESAKI DIODES.

J.W.Easley and R.R.

J. appl. Phys., Vol. 31, No. 10, 1772-4 (Oct., 1960).

The fast neutron irradiation behaviour of germanium and si Esaki diodes has been experimentally examined. The dominant change produced is an increase in the "excess" current which is proportional to integrated neutron flux. The observed increase the vicinity of the current minimum is approximately 2.6×10^{-1} fast neutron for germanium and silicon diodes respectively. Substantial changes result in the voltage—current characteristics of diodes employed in the decade of exposure between 10^{16}-10^{17} fast neutrons/cm^2 for germanium diodes and between 10^{15}-10^{16} fast neutrons/cm^2 for silicon diodes. One kilomegacycle cavity oscillators employing germanium diodes exhibit a marked reduc in power output in the decade of exposure between 10^{16}-10^{17} fast neutrons/cm^2. The magnitude of the decrease is an approximate agreement with the observed bombardment reduction of diode neg conductance.

539.2 : 537

18030 THE EFFECT OF BOMBARDMENT WITH HIGH EN ELECTRONS ON THE ELECTRICAL CONDUCTIVIT OF SILICON AND THE DEPENDENCE OF THE RATE OF THE DEFECT FORMATION ON THE ORIENTATION OF THE CRYST WITH REFERENCE TO THE ELECTRON BEAM.

V.S.Vavilov, V.M.Patskevich, B.Ya.Yurkov and P.Ya.Glazunov.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1431-3 (July, 1960). In Russia

The maximum depth at which an increase in the electrical resistivity ρ of p-type Si single crystals, bombarded with 500 k electrons, could be detected was 0.6 mm and independent of the orientation of the crystal. The increase in ρ of the sub-surface layer (~ 0.1 mm) caused by bombardment in the direction parall to the $\langle 111 \rangle$ axis was considerably higher (from 160 to 2300 ohm than that due to bombardment in the $\langle 110 \rangle$ or $\langle 100 \rangle$ directions (from 160 to 1500 ohm cm), the resultant changes being permane at room temperature. M.H.Slob

539.2 : 537

18031 ANOMALOUS SURFACE CHANNELS ON SILICON p–JUNCTIONS.

R.Solomon.

J. appl. Phys., Vol. 31, No.10, 1791-9 (Oct., 1960).

A chopped-light spot has been used to explore the photoresp of silicon p—n junction surfaces. Anomalous channel responses extending in some cases to distances of 100 mils or more, have observed on accumulation layer and intrinsic barrier surfaces. phase shift of the induced a.c. photocurrent is measured as a fun of the distance of the light spot from the junction, and phase shift of more than 380° have been observed for the anomalous channels Experimental evidence is offered to show that the excessive phas shift is due to multiple trapping of the injected carriers at surfac interface states. Additional evidence indicates that the anomalou channels are a results of an interaction of the fringing field with the slow surface states.

539.2 : 537

18032 METAL PRECIPITATES IN SILICON p-n JUNCTION

A.Goetzberger and W.Shockley.

J. appl. Phys., Vol. 31, No. 10, 1821-4 (Oct., 1960).

Metal precipitates in junctions were found to cause excess reverse current below avalanche breakdown, which is conjecture to be due to Zener tunnelling at localized high-field points. This current varies as V^n where n is between 4 and 7. By a potential plotting method, it was shown that this excess current is not caus by a surface effect. Metal precipitates can be removed or preve by "gettering" from surface layers. Metallic coatings and certa glossy oxide layers were investigated. Results indicate that laye of Ni and Zn have a limited gettering effect. Glassy layers, especially those of boron and phosphorus, have the greatest getter effect.

539.2 : 537

18033 COLLISION IONIZATION IN SILICON. SATURATION OF THE EFFECT.

A.Zylbersztejn.

J. Electronics and Control, Vol. 8, No. 2, 97-101 (Feb., 1960). In French.

Describes measurements made at 20.75°K on current build-Conductivities are given as a function of electric field.

J.D.Cra

539.2 : 537.311

34 **SCATTERING ANISOTROPIES IN n-TYPE SILICON.** D.Long and J.Myers.

Rev., Vol. 120, No. 1, 39-44 (Oct. 1, 1960).

easurements were made of magnetoresistance effects in
l relatively pure samples of n-type silicon for the purpose of
ng information on scattering anisotropies. The results indi-
at the ratios of relaxation times parallel and perpendicular to
tant-energy-spheroid axis in the six-valley conduction band of
are $\tau_{\parallel}/\tau_{\perp} \cong \frac{2}{3}$ for acoustic-mode intravalley lattice
ring and $\tau_{\parallel}/\tau_{\perp} > 1$ for ionized-impurity scattering. Inter-
lattice scattering, important at higher temperatures, is iso-
.

539.2 : 537.311

35 **SHALLOW IMPURITY TRAPS AND ELECTRON TRANSFER DYNAMICS IN N-TYPE SILICON AT LIQUID
JM TEMPERATURES.** A.Honig and R.Levitt.

Rev. Letters, Vol. 5, No. 3, 93-6 (Aug. 1, 1960).

ombined photoconductivity and spin resonance experiments
been performed on boron-compensated phosphorus-doped
n. From these the electron transfer rate from neutral
horous to neutral boron, and the ratios of certain trapping
-sections have been determined. P.T.Landsberg

539.2 : 537.311 : 538.27

**PPLICATIONS OF THE TECHNIQUE OF ELECTRONIC AND
EAR DOUBLE RESONANCE (ENDOR) TO DONORS IN SILI-**
See Abstr. 16174

539.2 : 537.311

36 **PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTING SYSTEMS. V. THE LIMITS OF
IATION OF ORDERED SOLID SOLUTIONS IN THE
$-In_2Se_3$ SYSTEM AND THE ELECTRICAL PROPERTIES OF
Se_4.** B.T.Kolomiets and A.A.Mal'kova.

verdogo Tela, Sbornik [Supplement] II, 32-8 (1959). In Russian.

For Pt IV see Abstr. 3486 of 1959 and for Pt VI see Abstr. 601
60. X-ray diffraction analysis and measurements of micro-
ess showed that homogeneous ordered solid solutions with
erite structure were formed between 45 and 60% CdSe. At
% composition a chemical compound ($CdIn_2Se_4$) was formed.
compound had sphalerite structure, forbidden band-width of
eV and electrical conductivity of 1-500 ohm^{-1} cm^{-1} which re-
ed constant between 20 and 250°C. The high conductivity of
Se_4 was due to a high density of carriers supplied by impurities
ctivation energy of impurity carriers was 0.025 eV) or due to
resence of vacancies. The conductivity of $CdIn_2Se_4$ could be
d greatly by introduction of foreign impurities or an excess of
f the components. A.Tybulewicz

539.2 : 537.311

037 **SOME SPECIFIC FEATURES OF THE THERMALLY INDUCED CONDUCTIVITY OF CdS SINGLE CRYSTALS.**
Trofimenko, G.A.Fedorus and A.K.Razmadze.

tverdogo Tela, Vol. 2, No. 6, 1141-7 (June, 1960). In Russian.

In an experimental study of the thermally induced conductivity
) in CdS single crystals, the existence of a temperature depend-
of the capture cross-section for electrons in crystals with an
ss of sulphur was revealed, and the extent of trapping at maxi-
conductivity was measured. The photosensitivity of the speci-
was correlated with the area contained by the appropriate TIC
es, and the effect of the glow discharge on the magnitude of the
peaks was tentatively investigated. M.H.Sloboda

539.2 : 537.311

8038 **THE PROBLEM OF SPACE-CHARGE LIMITED CURRENTS IN CdS CRYSTALS.** E.Schnürer.

aturforsch., Vol. 15a, No. 7, 645-7 (July, 1960). In German.

CdS crystals 0.3-0.5 mm thick, subjected to a glow discharge,
provided with Au contacts. The glow discharge treatment
ed an electron enrichment layer at the surface. Under
radiation, ohmic behaviour was observed below 5 V and above
V, in the intermediate region the current increased superlinearly
voltage. In this region, space-charge limited currents could
unt for the observed characteristics. J.Franks

539.2 : 537.311

8039 **PRECIPITATION OF COPPER IN GALLIUM ARSENIDE.** J.M.Whelan and C.S.Fuller.

ppl. Phys., Vol. 31, No. 8, 1507-8 (Aug., 1960).

Changes in the electrical properties associated with the precipitation of Cu were studied and after annealing a shallow acceptor ionization level was found at 0.021 eV in addition to the level formed at 0.14 eV introduced by the addition of Cu above 1000°C. The authors tentatively conclude that the shallow acceptor is associated with a Ga vacancy or a Ga vacancy—impurity complex. I.Cooke

539.2 : 537.311

18040 **THERMAL CONVERSION IN N-TYPE GaAs.** J.S.Wysocki.

J. appl. Phys., Vol. 31, No. 9, 1686 (Sept., 1960).

N-type GaAs with a carrier concentration of 5×10^{16} cm^{-3} or less converted to p-type when heated for short periods to 800°C. This was found to arise from Cu diffusion, the Cu probably being introduced from the etching reagents. C.A.Hogarth

539.2 : 537.311

18041 **GALLIUM ARSENIDE AS A SEMI-INSULATOR.** J.W.Allen.

Nature (London), Vol. 187, 403-5 (July 30, 1960).

Gallium arsenide containing oxygen impurity can have a resistivity greater than 10^6 ohm cm. It is suggested that oxygen can enter the lattice in two different sites: in one site it is electrically inactive, in the other it acts as an acceptor with a level near the middle of the forbidden gap. If there is an energy difference between these two states the number of oxygen atoms which act as acceptors will be determined by the donor concentration. The material thus becomes automatically compensated, and there are very few free carriers. Similar considerations may apply to CdS. C.Hilsum

539.2 : 537.311

18042 **BREAKDOWN AND LIGHT EMISSION IN GALLIUM PHOSPHIDE DIODES.** J.W.Allen and P.E.Gibbons.

J. Electronics and Control, Vol. 7, No. 6, 518-22 (Dec., 1959).

Experiments are described which suggest that the electroluminescence observed for forward bias is due to radiative recombination of injected carriers via impurity levels, while that for reverse bias is emission by hot carriers arising from avalanche breakdown. The diodes may be useful as sources of very fast light pulses. C.A.Hogarth

539.2 : 537.311

18043 **ELECTRIC PROPERTIES OF InSb P—N JUNCTIONS.** Y.Marfaing.

C.R.Acad. Sci. (Paris), Vol. 250, No. 22, 3608-10 (May 30, 1960). In French.

Exodiffused junctions were examined by a pulse technique. The forward current can be expressed by the relation

$$I = I_S\left[\exp\frac{eV}{\beta kT} - 1\right] + GV$$

where V is the applied voltage and G is the conductance measured in the ohmic region near the origin. β is a constant for a junction and was found to have values between 1.7 and 3, while I_S was about 8μA. It is suggested that carrier injection must provide an important contribution to the forward current. The reverse current does not saturate, the characteristic showing a discontinuity indicating carrier multiplication at some voltage depending on the temperature. Mechanisms other than carrier injection are necessary to describe the reverse biased behaviour. I.Cooke

539.2 : 537.311

18044 **GALVANOMAGNETIC EFFECTS IN THREE-BAND SEMICONDUCTORS - EXPERIMENTS WITH p-TYPE InSb.** G.Fischer.

Helv. phys. Acta, Vol. 33, No. 5, 463-88 (1960).

The resistivity and Hall coefficient of a p-type single crystal of InSb have been measured as a function of magnetic field strength and temperature. The ranges covered extend from 0 to ± 8 kOe and from 78° to 300°K. Equations are derived for the Hall effect and the magnetoresistance which are applicable to isotropic semiconductors containing an arbitrary number of non-interacting degenerate bands, and valid for any magnetic field strength. In particular a three-band model is discussed in detail and formulae are given by which it is possible to derive values for the concentrations and mobilities of the various charge carriers from the dependence of the Hall coefficient and resistivity on the magnetic field. This model appears valid for p-type InSb in the extrinsic range. It predicts the presence of two kinds of hole with highly different mobilities. In the intrinsic range the model fails by giving a negative concentration of high mobility holes. An alternative model consisting of only one band of holes but taking various scattering mechanisms into account is found to be equally good at low temperatures, but also inadequate in the intrinsic range. The failure of these two models at high temperatures supports Ehrenreich's theory of predominantly polar scattering between 200° and 500°K.

539.2 : 537.311

18045 ANOMALOUS BARRIER CAPACITANCE IN P–N JUNCTIONS OF InSb. C.A.Lee and G.Kaminsky.

J. appl. Phys., Vol. 31, No. 10, 1717-19 (Oct., 1960).

Reverse bias transition capacitance measurements on alloy diodes of InSb at 78°K give values a factor of three times those calculated from normal diode theory. This result is in contrast to the reasonable agreement obtained for diodes of germanium and gallium arsenide in a comparable doping range. The experimental techniques are critically reviewed and an attempt made to assess the implications of the results.

539.2 : 537.311

18046 ELECTRICAL PROPERTIES OF CERTAIN $A^{III}B^{V}$ COMPOUNDS. D.N.Nasledov.

J. Chim. phys., Vol. 57, No. 6, 479-85 (June, 1960). In French.

Experiments with high purity InSb have revealed anomalous magnetoresistance and Hall effects. Non-ohmic conductivity is observed at liquid helium temperatures. Anomalous magnetoresistance is also observed in GaAs. C.D.Cox

539.2 : 537.311

18047 MAGNETO-TUNNELLING IN InSb. A.R.Calawa, R.H.Rediker, B.Lax and A.L.McWhorter.

Phys. Rev. Letters, Vol. 5, No. 2, 55-7 (July 15, 1960).

The current–voltage characteristics of InSb tunnel diodes were measured at 77°K in magnetic fields up to 88 000 G. The tunnelling current decreased as the magnetic field increased because of the creation of magnetic sub-bands, and their shift in energy with magnetic field. Theoretical calculations gave good agreement with experiment. A similar but smaller effect was observed in germanium diodes. C.Hilsum

539.2 : 537.311

18048 OBSERVATION OF STARK SPLITTING OF ENERGY BANDS BY MEANS OF TUNNELLING TRANSITIONS.

A.G.Chynoweth, G.H.Wannier, R.A.Logan and D.E.Thomas.

Phys. Rev. Letters, Vol. 5, No. 2, 57-8 (July 15, 1960).

The energy states available to an electron in a crystal form a series of Stark ladders if a uniform electric field is present. This effect was observed in experiments on InSb tunnel diodes at 4°K, the conductance-bias characteristics showing a fine structure at a forward bias between 100 and 130 mV. C.Hilsum

539.2 : 537.311

18049 MEASUREMENT OF EFFECTIVE MASS OF ELECTRONS IN InP BY INFRA-RED FARADAY EFFECT.

T.S.Moss and A.K.Walton.

Physica, Vol. 25, No. 11, 1142-4 (Nov., 1959).

The effective mass in fairly pure polycrystalline n-type material has been calculated to be 0.073 m_0, which confirms that the lowest conduction band minimum occurs at k000. An unpublished report by Ehrenreich suggests that the effective mass (m^*) is related to the energy gap (E_g) and the spin–orbit splitting (Δ) by:

$$m^*\{2E_g^{-1} + (E_g + \Delta)^{-1}\} = \text{const.}$$

This relationship has been tested for various materials and found to be reasonably accurate. The constant is 0.145 ± 7%. J.W.Sturgess

539.2 : 537.311

18050 THE ELECTRICAL CONDUCTIVITY AND PERMITTIVITY OF LEAD SULPHIDE LAYERS AT 10^{10} c/s.

V.G.Erofeichev and L.N.Kurbatov.

Fiz. tverdogo Tela, Sbornik [Supplement] I, 133-43 (1959). In Russian.

The dark and photoconductivities and permittivity of vacuum-deposited or electrodeposited PbS layers were measured at 10^{10} c/s, using the method of field perturbation in a cylindrical cavity resonator (Abstr. 3458B of 1957; Bell Syst. tech. J., Vol. 36, No. 2, 427-48, March, 1957). The 10^{10} c/s dark conductivity was greater (1-2 $\text{ohm}^{-1}\,\text{cm}^{-1}$) than the d.c. conductivity (0.02-0.5 $\text{ohm}^{-1}\,\text{cm}^{-1}$). The microwave permittivity was much greater than the value expected for a homogeneous material; this was taken to indicate that PbS layers consisted of grains of high conductivity separat by poorly conducting regions. The 10^{10} c/s photoconductivity w lower than the d.c. conductivity. The authors describe also a of measuring the photocarrier lifetime. Weak illumination was modulated sinusoidally and this produced sinusoidal modulation the 10^{10} c/s photoconductivity signal. The lifetime τ was found $\tan\varphi = \omega\tau$, where φ is the phase shift between the illumination the photoconductivity signal, and ω is the light modulation freq The method produced results in rough agreement with the "tau values. A.Tybul

539.2 : 537.311 : 621.3

18051 THE ELECTRICAL CHARACTERISTICS OF SOME TYPES OF SELENIUM RECTIFIERS.

I.Kh.Geller and P.V.Sharavskii.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1441-9 (July, 1960). In Russ

Voltage–current characteristics, capacitances and resist of 4 types of selenium rectifier (containing, respectively, CdS 2 forms, TlSe and CdSe) are determined and discussed in relat to the electron–hole transitions in the rectifier material. R.F.S.Hea

539.2 : 53

18052 TIME RATE OF DECREASE OF ELECTRICAL CONDUCTIVITY OF POLYCRYSTALLINE [HEXAG SELENIUM. T.Sekiguti.

Sci. Pap. Inst. Phys. Chem. Res. (Tokyo), Vol. 53, No. 1512-23, 120-4 (Sept., 1959).

The temperature dependency of the time rate of decrease o electrical conductivity after rapid cooling was observed. The behaviour of the conductivity below 20°C is different from that above 20°C. This temperature roughly coincides with that of th glass transformation of amorphous selenium. This suggests th the relaxation of conductivity is caused by the volume relaxation amorphous selenium in the polycrystal.

539.2 : 537

18053 ELECTRICAL PROPERTIES OF ELECTROLUMINE CENT SiC CRYSTALS. E.Nagy and J Weiszburg.

Acta phys. Hungar., Vol. 8, No. 1-2, 235-9 (1957). In German.

The current-voltage characteristic of the specimens was observed to follow the theoretical prediction for the reverse cu through an exhaustion barrier modified by the image force corr tion. It also showed an appropriate temperature variation of current. Deterioration of the surface at the contact, or prolong exposure of a crystal to air, produced a conducting layer which could be removed by grinding. I.C

539.2 : 53

18054 ON SOME PROPERTIES OF THALLIUM SELENIDE SINGLE CRYSTALS.

G.A.Akundov, G.B.Abdullayev and G.D.Guseinov.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1518-21 (July, 1960). In Russ

Single crystals of p-type ThSe, prepared by direct fusion of Th Se in vacuum followed by zone refining, had a tetragonal crystal la (a = 8.02 A, c = 7.0 A), generated thermo-e.m.f. ≅400 μV/°C, a were sensitive to infrared radiation. The temperature depende of the electrical conductivity, carrier concentration, and mobili was determined in the range 20-280°C. M.H.Sl

539.2 : 53

18055 BOMBARDMENT CONDUCTIVITY IN SYNTHETIC ZINC SULPHIDE CRYSTALS.

G.F.Alfrey and K.N.R.Taylor.

J. Electronics and Control, Vol. 8, No. 4, 301-4 (April, 1960).

Bombardment conductivity pulses have been observed in crystalline zinc sulphide due to irradiation with 5.3 MeV alpha particles. The counting rate and maximum pulse amplitude hav been examined as a function of the applied voltage. The results interpreted in terms of an exhaustion barrier at the negative el trode and the properties of this barrier obtained.

539.2 : 53

18056 EFFECT OF OXYGEN ON SEMICONDUCTIVITIES MESONAPHTHODIANTHRENE AND MESONAPHTH DIANTHRONE. H.Kuroda and E.A.Flood.

J. chem. Phys., Vol. 33, No. 3, 952-3 (Sept., 1960).

The d.c. conductivity of thin evaporated films of mesonapht dianthrene (I) and mesonaphthodianthrone (II) were measured as functions of time, temperature and oxygen pressure. In both ca ation of the form

$$\sigma = \sigma_1 \exp(-E_1/kT) + \sigma_2 \exp(-E_2/kT)$$

he experimental results with approximately similar values, 74 eV, E_2 = 0.40 eV(I), and 0.43 eV(II) for the two compounds. eased with oxygen pressure in I, but decreased in II, while σ_1 altered in both. It is suggested that oxygen creates a new of carriers in I but reduces the concentration in II. Similar of oxygen pressure on e.s.r. absorption are noted [Matsunaga, J. Chem., Vol. 38, No. 3, 323-8 (March, 1960)], and it is ted that oxygen molecules form a molecular complex with the arbon molecules of I, giving a source of unpaired electrons.

R.G.C.Arridge

539.2 : 537.311 : 621.382

57 THE OSCILLISTOR -NEW TYPE OF SEMICONDUCTOR OSCILLATOR. R.D.Larrabee and M.C.Steele.

l. Phys., Vol. 31, No. 9, 1519-23 (Sept., 1960).

new magneto-oscillatory effect has been observed in the on—hole plasma within a semiconductor. The plasma can oduced by such agents as contact injection and optical or al excitation of minority carriers. When the semiconductor men is subjected to an electric field (through suitable contacts) magnetic field, current oscillations can be detected across es load resistance. This device has been termed the oscillis- suggest a semiconductor oscillator. The experiments sug- hat the oscillistor mechanism involves a magnetically induced ction of the bulk plasma of electrons and holes with the ed free surface areas of the specimen.

539.2 : 537.311 : 621.382.2

058 AVALANCHE BREAKDOWN IN A DIODE WITH A LIMITED SPACE-CHARGE LAYER. Z.S.Gribnikov.

verdogo Tela, Vol. 2, No. 5, 854-6 (May, 1960). In Russian.

iscusses lowering of the breakdown voltage in diodes with a distance between the rectifying and "ohmic" contacts using ssumption that the ionization coefficient of carriers depends gly on the field.

A.Tybulewicz

539.2 : 537.311 : 536.3

EMICONDUCTOR INFRARED DETECTORS. See Abstr. 18015

conductivity

539.2 : 537.312

059 BULK PHOTOEFFECTS IN INHOMOGENEOUS SEMICONDUCTORS. C.D.Cox.

d. J. Phys., Vol. 38, No. 10, 1328-42 (Oct., 1960).

A photoelectromotive force is observed when a semiconductor uminated in the region of a bulk inhomogeneity. A theoretical ession for the bulk photo-e.m.f. is derived which is valid for all s of illumination in the region of an arbitrary impurity density ient. With appropriate approximations the complete expression mplified for the cases of weak and saturation illumination in nogeneous extrinsic and nearly intrinsic semiconductors, and in and l—h junctions. The theoretical relation between bulk photo- f. and photo-conductive resistance decrease is examined. Bulk -e.m.f. measurements were made on inhomoegneous german- filaments. These showed the photo-e.m.f. to be linear with weak illumination. Strong illumination photo-e.m.f. was shown to de- on the impurity distributions adjacent to the illuminated re- s. The ratio of bulk photo-e.m.f. to photoconductive resistance ease was constant at weak illumination in agreement with the ry. Measurements of the photo-e.m.f. as a function of tempera- showed a close agreement with the predicted behaviour in the intrinsic range of conductivity.

539.2 : 537.312

8060 THE INFLUENCE OF TRAPPING LEVELS IN SEMICONDUCTORS ON THE STATIONARY PHOTOCON- CTIVITY AND ON THE LIFETIME OF MINORITY CARRIERS. .Grinberg, L.G.Paritskii and S.M.Rȳvkin.

tverdogo Tela, Vol. 2, No. 7, 1545-61 (July, 1960). In Russian.

Examines the effect for both photoconducting insulating crystals the CdS group) and for semiconductors with a large dark con- ivity (as Ge). After a qualitative discussion, calculations made for the following cases: (1) high level of injection and a ll concentration of recombination centres; (2) a semiconductor two types of trapping level, a high level of injection and a small centration of recombination centres; (3) a high level of injection and a large concentration of recombination centres; (4) a low level of injection and any concentration of recombination centres. The results in each case are illustrated graphically and the effect on the dependence of τ_n, τ_p and $\Delta\sigma$ on temperature and light intensity is treated briefly.

R.Berman

539.2 : 537.312

18061 INDUCED INFRARED PHOTOSENSITIVITY IN CERTAIN SEMICONDUCTORS. E.N.Arkad'eva and S.M.Rȳvkin.

Fiz. tverdovo Tela, Vol. 2, No. 8, 1889-90 (Aug., 1960). In Russian.

Photoconductivity caused by preliminary illumination by visible light was measured in Sb_2Se_3, CdSe and CdTe at 85°K. In the first two the additional photoconductivity decayed quickly (~ 1/2 hr) but in CdTe it remained unchanged for several hours (as in CdS).

D.J.Huntley

539.2 : 537.312

18062 DETERMINATION OF THE RECOMBINATION CONSTANTS AND DEPTH OF A P–N JUNCTION FROM THE SPECTRAL CHARACTERISTICS OF PHOTOELEMENTS. V.K.Subashiev, G.B.Dubrovskii and V.A.Petrusevich.

Fiz. tverdovo Tela, Vol. 2, No. 8, 1978-80 (Aug., 1960). In Russian.

It is shown how l_n — the width of the n region, L_p — the diffusion length of holes in the n region, and s/D_p — the ratio of the surface recombination velocity to the hole diffusivity in the n region can be derived from measurements of the short-circuit current. It is necessary to measure only at two values of the wavelength, at which there is strong absorption, and two values of the surface recombination velocity; thus the method could be used in the mass production of photoelements.

D.J.Huntley

539.2 : 537.312

18063 GRAIN-BOUNDARY PHOTORESPONSE. W.W.Lindemann and R.K.Mueller.

J. appl. Phys., Vol. 31, No. 10, 1746-51 (Oct., 1960).

Measurements of the sensitivity of grain-boundary photodetector indicate an expected minimum detectable power of better than 10^{-14}W. Major factors governing the sensitivity are the minority carrier life time and the distance of the boundary from the irradiated surface. Spectral measurements show an added absorption edge response at about 1.67 μ and 1.72 μ. This added response could be caused by deep-lying acceptor levels or by excitons with a long lifetime. However, the experimental evidence points to direct absorption at the grain boundary as the most likely reason for the absorption edge irregularities.

539.2 : 537.312

18064 THE PHOTO VOLTAGE AT THE SURFACE OF SEMICONDUCTORS. A.Surduts.

J. Phys. Radium, Vol. 20, No. 12, 980-1 (Dec., 1959).

Expressions are obtained for a non-degenerate semiconductor, neglecting the slow recombination states but including surface recombination and fast donor and acceptor centres. Experiments with n-type Ge agree with the theory after assuming the densities of the donor and acceptor centres to be very small. Further work on the spectral response of the photo voltage is contemplated.

D.J.Oliver

539.2 : 537.533

PHOTOEMISSION AND VALENCE BAND STRUCTURE OF ALKALI IODIDES. See Abstr. 17029

539.2 : 537.312

18065 PHOTOCONDUCTIVITY OF ANTHRACENE. H.Boroffka.

Z. Phys., Vol. 160, No. 1, 93-108 (1960). In German.

The dependence of the photocurrent on voltage, light intensity and electrode separation and also the decay-time of the photocurrent is measured. All these measurements are largely influenced by the electrode material. The results obtained with Cu I and Al electrodes and also with insulating electrodes are given and the different behaviour is discussed. The mean ranges and the mobility of the holes which are mainly responsible for the photocurrent are discussed.

539.2 : 537.312 : 541.14

18066 PHOTOCONDUCTIVITY AND PHOTOLYSIS IN CADMIUM IODIDE. R.A.Fotland.

J. chem. Phys., Vol. 33, No. 3, 956-7 (Sept., 1960).

Crystals as large as 2 × 4 in. were grown by a Bridgman technique and others from solution with similar electrical properties.

The optical absorption edge is at 3.2 eV and photoconduction response in the 3 to 3.3 eV region shows a quantum efficiency of 1% for fields of 1 kV/cm. Larger transient currents are obtained at onset and removal of fields. Rise and decay of photocurrents occupy $\cong$30 sec. Darkening of the precipitated iodide (on filter papers) by light shows a similar wavelength dependence to that for photoconduction. Crystals or powders showed no darkening, indicating the essential presence of moisture for darkening (probably by removal of halogen). G.F.J.Garlick

539.2 : 537.312 : 535

PHOTOELECTRIC PROPERTIES OF THIN CdSe LAYERS.
See Abstr. 18113

539.2 : 537.312

18067 THE INFLUENCE OF TRAPPING LEVELS ON THE RELAXATION OF PHOTOCONDUCTIVITY IN CdS SINGLE CRYSTALS. L.G.Paritskii and S.M.Rȳvkin.
Fiz. tverdogo Tela, Vol. 2, No. 3, 547-57 (March, 1960). In Russian.

Describes experiments to examine the initial stages in the growth of photoconductivity up to several tens of microseconds. The results can be qualitatively (in some cases quantitatively) explained by capture of carriers at α trapping levels (for which thermal equilibrium is reached in an effective time much less than the lifetime determined by recombination). These processes also affect subsequent behaviour. There was no influence of intensity of illumination on the initial slope, so that the recombination characteristics, and not the excitation processes, probably determine the photoconductive properties. It is suggested that the case of copper oxide should be reconsidered in the light of this. R.Berman

539.2 : 537.312

18068 THE EFFECT OF ANNEALING IN VACUUM AND SULPHUR VAPOUR ON THE STRUCTURE OF CdS SINGLE CRYSTALS. K.W.Böer, H.Gutjahr and H.Hornung.
Z. Phys., Vol. 159, No. 5, 495-504 (1960). In German.

The spectral distributions of photoconductivity were obtained at room temperature and liquid air temperature, and conductivity glow curves were measured for CdS single crystals pre-treated by annealing in vacuum, and in sulphur vapour, before being exposed to the atmosphere at room temperature. A number of defect levels are introduced by these treatments; after annealing in vacuum trapping levels are produced at 0.35, 0.45 and 0.55 eV below the conduction band. J.Franks

539.2 : 537.312 : 537.2

SPECTRAL DEPENDENCE OF CdS PHOTOCONDUCTIVITY.
See Abstr. 18088

539.2 : 537.312

18069 STUDY OF PHOTOVOLTAIC EFFECTS (LATERAL AND TRANSVERSE) IN P—N JUNCTIONS OF INDIUM ANTIMONIDE. G.Courrier and Y.Marfaing.
C.R.Acad. Sci. (Paris), Vol. 250, No. 23, 3798-800 (June 8, 1960). In French.

The measurement of infrared sensitivities of photovoltaic cells is described. C.D.Cox

539.2 : 537.312

18070 ELECTRON MICROSCOPE STUDIES OF PHOTOSENSITIVE PbS LAYERS. M.Michailov.
C.R. Acad. Bulg. Sci., Vol. 13, No. 2, 143-5 (April, 1960). In French.

Photosensitive layers of PbS have been studied under the electron microscope, using cellulose and quartz replicas. Small variations in the conditions of preparation of the layers are found to produce considerable variations in structure. A structural photovoltaic effect often observed in PbS layers is thought to depend not on the texture of the layers but on factors such as intercrystallite contact in the bulk of the layer and the effects of oxygen on the layer. C.H.B.Mee

539.2 : 537.312

18071 SOME SPECIFIC FEATURES OF PHOTOCONDUCTIVITY OF MERCURIC SULPHIDE. N.I.Butsko.
Fiz. tverdogo Tela, Vol. 2, No. 4, 629-32 (April, 1960). In Russian.

In a study of vacuum deposited, high purity α-HgS crystals, the relationship between stationary photoconductivity $\Delta\sigma_0$ and illumination intensity, the temperature dependence of dark- and photoconductivity, the current/voltage characteristics, photoconductivity spectrum, and the variation of $\Delta\sigma_0$ with the illumination time were investigated. α-HgS was found to retain the illumination-induced properties for a relatively long time (~10 min). The character of the rise an decay of $\Delta\sigma_0$ on the application and removal of illumination indicated that α-HgS resembles in this respect substances characterized by photoconductivity of the hyperbolic type i.e. InSe, Tl_2S, Bi_2S_3, and CdS. M.H.Sl

539.2 : 53

18072 PHOTOSTIMULATED ELECTRON EFFECTS IN COLOURED NaCl CRYSTALS. A.Bohun.
Acta phys. Hungar., Vol. 8, No. 1-2, 65-73 (1957). In German.

Thermionic emission, thermoluminescence, photoemission absorption were measured on NaCl crystals, coloured by irradi with X-rays. Several small peaks occurred in the optical and thermal curves, indicating that some absorption bands due to de existed in the F-centre absorption band. Comparison of photoemission and photoconductivity with absorption curves showed t the emitted electrons, originating from the various centres, tra the conduction band before leaving the crystal. J.Fr

539.2 : 53

18073 THE PHOTOCONDUCTIVITY OF LAYERS OF SULP SUBJECTED TO THE ACTION OF MERCURY VAP
M.I.Korsunskii, N.S.Pastushuk and G.D.Mokhov.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1581-3 (July, 1960). In Russ

Layers of sulphur mounted on glass were subjected to the a of mercury vapour. A considerable increase in photoconductivi was observed; the amount of the increase varies over the optica spectrum. At the same time, the dark current exhibits consider inertia effects. A.E.I. Research Labor

539.2 : 53

18074 THE INNER PHOTOEFFECT AND PHOTODESORPT OF OXYGEN IN ZINC OXIDE. S.Kȳnev and E.Vate
C.R. Acad. Bulg. Sci., Vol. 12, No. 1, 33-6 (Jan.-Feb., 1959). In Russian.

The temperature dependence of photodesorption of O in ZnO determined by measuring its dark and photoconductivity. It was established that photodesorption is induced by light of both funda mental and impurity absorption wavelength (λ = 546 and 578 mμ respectively. The effect of the current carriers on the a.c. and d.c. conductivity of ZnO was also investigated. M.H.Slo

Thermoelectric Properties

539.2 : 53

18075 A METHOD FOR RAPID PRECISION MEASUREMEN OF THE THERMOELECTRIC POWER OF SEMICONDUCTORS. O.V.Emel'yanenko and F.P.Kesamanlȳ.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1494-6 (July, 1960). In Russia

An apparatus is described in which the thermocouples are clamped to the specimen. Temperature differences between a thermocouple junction and the specimen are avoided by heating thermocouple near the junction so that it has the same output as that of another thermocouple similarly situated but not quite touing the specimen. Temperatures were measured with an accura of 0.1°C and an experimental point took 10-15 min. Results for specimens of GaAs with 0.3, 1 and 3% Se are given for temperat 25-150°C. D.J.Hu

539.2 : 53

18076 MEASUREMENTS OF THERMOELECTRICITY BEL 1°K. III.
D.K.C.MacDonald, W.B.Pearson and I.M.Templeton.
Phil. Mag. (Eighth Ser.)., Vol. 4, 380-3 (March, 1959).

For Pt II, see Abstr. 2364 of 1959. Measurements are repo of the absolute thermoelectric force below about 1.5°K of specim of Ni, Pd, Fe, Pt, Co, Rb and Cs. The results are presented as tabulated values at about 1.25°K for all specimens examined (tw of differing residual resistance ratio of all except Co) and also i graphical form, showing temperature dependence, for Ni and Rb. In Ni, Pd, Fe, Pt and Rb, it was found that increased purity of specimen led to a change in sign of the effect from positive to ne tive together with an increase in magnitude; only in Pt though di the magnitude approach that of Au. One specimen of Co only was examined, showing a normal force. Cs did not show other than a positive force. L.Mack

539.2 : 537.32 : 538.2

77 THE THERMOELECTRIC, GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS OF MONOVALENT LS. IV. EFFECT OF THE NON-EQUILIBRIUM DISTRI- ON OF THE PHONONS. M.Tsuji.

ys. Soc. Japan, Vol. 14, No. 5, 618-32 (May, 1959).

or previous parts, see Abstr. 8177-9 of 1959. The effects of n-equilibrium distribution of the phonons on the electrical and al conductivities, thermoelectric power, and transverse no- and thermomagnetic effects of metals are calculated. It is that Onsager's reciprocal relation holds, actually, in the case non-equilibrium distribution of the phonons with presence of a etic field. For the spherical band model, the effect on the shausen—Nernst coefficient is not so large as appears in the ture. For an anisotropic band model, the phonon drag terms r in the Ettingshausen, Ettingshausen—Nernst and Righi—Leduc cients.

539.2 : 537.32

078 THE CONTRIBUTION DUE TO PHONON DRAG TO THE THERMOPOWER OF ALUMINIUM.

de Vroomen, C.van Baarle and A.J.Cuelenaere.

ica, Vol. 26, No. 6, 19-32 (Jan., 1960).

Experiments are described on the thermoelectric power of inium between 2° and 9° K. A contribution due to phonon drag unting to $-1.4 \times 10^{-10}T^3$V/ deg K has been isolated from the thermoelectric power. This value is in agrement with the y of Klemens, Macdonald, and others, the value of N_a (the ber of electrons per atom) being taken as 1.0. Although a large rgence of values occurs in the six samples studied, there is ng in the results which could justify the idea that theories on moelectricity are fundamentally wrong.

539.2 : 537.32

079 THE EFFECT OF IMPURITIES ON THE THERMO-ELECTRIC PROPERTIES OF A Sb_2Te_3—Bi_2Te_3 SOLID UTION. G.V.Kokosh and S.S.Sinani.

tverdogo Tela, Sbornik [Supplement] I, 89-99 (1959). In Russian.

A study of the thermoelectric properties of the 74 mol.% e_3 + 26 mol.% Bi_2Te_3 solid solution showed that Ag, Cu, Zn, Cd, Pb and Fe behave as acceptors in this solution, and I and Te ve as donors. Optimum amounts of these impurities produce ples with $Z = \alpha^2\sigma/\kappa$ up to 0.003 deg^{-1} (α is the thermoelectric r in $\mu V.deg^{-1}$, σ is the electrical conductivity in $ohm^{-1}.cm^{-1}$ κ is the thermal conductivity in $cal.cm^{-1}.sec^{-1}.deg^{-1}$). The perature dependences of the electrical conductivity and thermo-tric power were determined for samples with various carrier ities.

A.Tybulewicz

539.2 : 537.32

8080 THERMOELECTRICITY AND THERMAL CONDUCTIVITY IN THE LEAD SULFIDE GROUP OF ICONDUCTORS. D.Greig.

s. Rev., Vol. 120, No. 2, 358-65 (Oct. 15, 1960).

The thermal conductivity and thermoelectric power of six cimens of PbS and one each of PbSe and PbTe were measured at peratures ranging from 4° K to 100° K. In the same tempera- region the charge carrier mobility in these samples was rmined from measurements of electrical resistivity and Hall fficient. Four of the PbS samples were natural and n-type, le the other specimens were synthetic and p-type. The synthetic ples contained only a few single crystals but two of the natural cimens were highly polycrystalline. At low temperatures the rge carrier mobilities tend to high constant values similar to se reported elsewhere in single crystals of the same materials. m an estimate of the scattering cross-section of the point ects evidence is found for explaining this behaviour in terms of tallic rather than semiconducting properties. Maxima attributed honon drag were observed below 20° K in the thermoelectric er of the specimens of highest thermal conductivity. The rmal conductivity was similar in all samples at 100° K but ied by as much as two orders of magnitude at 10° K. In order to lain these results it is necessary to consider scattering of nons by point imperfections, free electrons, and dislocations.

539.2 : 537.32

8081 THE THERMOELECTRIC POWER OF ANNEALED AND COLD-WORKED SILVER AND GOLD AT LOW MPERATURES. W.B.Pearson.

ad. J. Phys., Vol. 38, No. 8, 1048-58 (Aug., 1960).

Most of the low-temperature thermoelectric behaviour of annealed and cold-worked silver and gold samples can be accounted for satisfactorily by using Kohler's equation, $S = \Sigma W_i S_i / \Sigma W_i$, to calculate as a function of temperature the diffusion thermoelectricity under the influence of various competing scattering mechanisms in the metals, and by taking account of the phonon drag contribution to the thermoelectricity. New data are presented and interpreted.

539.2 : 537.32

18082 DETERMINATION OF THE THERMOELECTRIC POWERS OF URANIUM AND PLUTONIUM. P.Costa.

J. nuclear Mater., Vol. 2, No. 1, 75-80 (March, 1960). In French.

The thermoelectric power of uranium and plutonium have been measured by a differential method. In agreement with previous measurements by Waldron and Lee, a high value of thermoelectric power has been found for the α and β phases of plutonium, and a low value for the δ and ϵ phases, particularly the δ. This last result rules out Varley's explanation for the negative thermal expansion coefficient of the β phase. The observed variation of the thermoelectric power with temperature is slightly different from that reported by Waldron and Lee.

Dielectric Properties

539.2 : 537.2

18083 THE MAXWELL—WAGNER—SILLARS EFFECT, DESCRIBING APPARENT DIELECTRIC LOSS IN INHOMOGENEOUS MEDIA. L.K.H.Van Beek.

Physica, Vol. 26, No. 1, 66-8 (Jan., 1960).

The Maxwell—Wagner formula, describing apparent dielectric loss due to the presence in a medium of spherical conducting particles, is in its generally cited form not correct. The correct derivation is shown to give a formula that is identical to one found by Sillars, who calculated the effect of spheroidal particles sparsely distributed in an insulator. It is therefore preferable to use this general formula which covers the Maxwell—Wagner effect as a special case.

539.2 : 537.2

18084 A ROD METHOD FOR DIELECTRIC CONSTANT MEASUREMENT; APPLICATION TO $(NH_4)_2H_3IO_6$ AT 3 cm WAVELENGTH. H.Gränicher and W.Schurter.

Z. angew. Math. Phys., Vol. 8, No. 5, 382-400 (Sept. 25, 1957). In German.

The complex permittivity can be measured in the cm wave region by inserting a cylindrical rod of the specimen across a short-circuited rectangular waveguide in the maximum of the $\vec{E}$-field. The resulting change in line-impedance is measured with a slotted line. This rod method was modified and tested with materials of known dielectric properties (Teflon, Polythene, Plexiglas and water). The conditions for best performance with specimens of high dielectric constants were established. Measurements were made at room temperature with single-crystals of $NH_4H_2PO_4$ and KH_2PO_4 parallel to the a and c axis. The permittivity ϵ_a of di-ammonium orthoperiodate $(NH_4)_2H_3IO_6$ was studied in the temperature range from +20° to −70° C. In the unpolarized and in the antiferroelectric phase the real part of the dielectric constant at 8740 Mc/s is less than half the static value. The results indicate that in ammonium periodate the dispersion frequency of ϵ'_a is in the range of 10^4Mc/s and that the relaxation time increases with rising temperature above the transition point. This behaviour represents the contrary of what is found with ferroelectrics.

539.2 : 537.2

18085 PROPERTIES OF THE MOTION OF FAST CURRENT CARRIERS IN POLAR CRYSTALS.

Yu.I.Gorkun and K.B.Tolpygo.

Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 1, 94-100; Disc. 101-3 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). Studies the dependence of the polaron wave-function, effective mass, etc. on velocity. The dependence of total energy (crystal + + electron) on velocity is found and calculated for NaCl, and also the rate of loss of energy. The derived mobilities are of the same order as the experimental values. The breakdown voltages are calculated for 12 alkali halides and compared with experiment. The theoretical values are always greater and the agreement is better for larger values of the ratio of polaron radius to lattice constant.

R.Berman

539.2 : 537.2

18086 THE KINETICS OF IONIC CONDUCTIVITY AND ELECTRICAL POLARIZATION IN SOLIDS. Yu.L.Khait.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 202-11; Disc. 212-14 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). Uses methods of statistical physics, with a mean free path, for calculating the speed of activated processes in solids in external fields. Processes occurring in a dielectric in an electric field can be connected with the heat conductivity and other non-electrical quantities. The mean free path must be derived from experiment. R.Berman

539.2 : 537.2

18087 RESTRICTED DIPOLE ORIENTATION IN SOLID DIELECTRICS. S.Sharan.
J.sci. industr. Res., Vol. 18B, No. 9, 353-61 (Sept., 1959).

The phenomenon of dipole orientation in hexadecyl and octadecyl bromides was studied using an r.f. bridge, specially constructed for the purpose. The circuit details of the bridge and the constructional details of the cell and the constant temperature bath are described. It was found that the amount of restriction on the dipole orientation process could be conveniently controlled by dissolving the polar substances in non-polar solid solvents such as paraffin wax in different concentrations. Octadecyl bromide in paraffin wax was examined in this way and the results obtained were examined theoretically. The results of this study show that this method opens up a line of investigating strongly polar substances and is capable of providing information on the nature of the interaction forces between dipoles in the solid state which are responsible for the restricted dipole orientation.

539.2 : 537.2 : 537.312

18088 INHOMOGENEOUS DISTRIBUTION OF FIELD AND CURRENT DENSITY IN CdS MONOCRYSTALS. K.V.Bër.
Izv. Akad. Nauk SSSR, Ser fiz., Vol. 24, No. 1, 36-42; Disc. 91-4 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). The time decay of the polarization field on single crystals of CdS was measured and found to be slower than an exponential decay. The electrostatic charge developed on the crystals as a function of applied voltage was investigated. Results are given for the spectral dependence of the photoconductivity of single crystals with the plane of polarization parallel to, and perpendicular to, the crystal axis. Current—voltage curves were also obtained for both static and pulsed voltages applied to the specimen. Some interesting photographs of the electrode region of the specimen were obtained using light of wavelength corresponding to the band gap. When a field is applied to the specimen, a dark pattern is seen near the cathode, and the separation distance is found to be temperature dependent. K.N.R.Taylor

539.2 : 537.2

18089 THE ELECTRICAL PROPERTIES OF SOME NATURAL WAXES. T.D.Callinan and A.M.Parks.
J. Electrochem. Soc., Vol. 107, No. 10, 799-803 (Oct., 1960).

The dielectric constants and dielectric loss factors of Carnauba, Ouricuri, and American Montan wax determined over a temperature range from −60° to 90°C and at frequencies of 0.1, 1, 10, and 100 kc/s, indicate that the component omega-hydroxy acid esters rotate in the solid state in the temperature region 25°-70°. From dipole measurements, the molecules were found to possess a trans—trans configuration.

539.2 : 537.2 : 532.7 : 621.315.61 : 621.317.335.3

18090 SOME DIELECTRIC INVESTIGATIONS AT 3.15 cm. AND 8.7 mm. BANDS. H.N.Srivastava.
J. sci. industr. Res., Vol. 18B, No. 11, 457-9 (Nov., 1959).

Dielectric constant and dielectric loss of four grades of steatite, two varieties of seedlac, rosin and mustard oil were determined at 8.7 mm; the steatite bodies were also examined for their dielectric constant and dielectric loss at 3.15 cm. The relaxation time of ethyl benzene was also evaluated. These studies showed that steatite is a suitable material for use as a lowloss dielectric in the 3 cm and 8 mm regions.

539.2 : 537.2

18091 SOME DIELECTRIC PROPERTIES OF SINGLE CRYSTALS OF $Pb_3NiNb_2O_9$.
I.E.Myl'nikova and V.A.Bokov.
Kristallografiya, Vol. 4, No. 3, 433-4 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New
Vol. 4, No. 3, 408-9 (March, 1960).

Measurements at 1, 45 and 450 kc/s show that the maxima the ϵ and tan δ versus temperature characteristics move to hi temperatures as the frequency is raised. Variations in hyster with temperature indicate either a transition from the para- to ferroelectric state, or the effect of a combination of nonlinear polarization and high dielectric losses. J.H.

539.2 :

18092 DIELECTRIC PROPERTIES OF MANGANESE DIOXIDE. I. V.G.Bhide and R.V.Damle.
Physica, Vol. 26, No. 1, 33-42 (Jan., 1960).

The variation with temperature, frequency and voltage of t electric conductivity, of the dielectric constant and of the loss for pyrolusite, MnO_2, are studied. It behaves as a semicondu The d.c. and a.c. conductivities show an anomaly at about 50°C At this temperature the value of the dielectric constant is a ma The loss factor has a minimum value in this temperature regio It is pointed out that this behaviour indicates that the substanc becomes ferroelectric below 50°C. This ferroelectricity is di in connection with the crystal structure.

539.2 :

18093 DIELECTRIC PROPERTIES OF MANGANESE DIOXIDE. II. V.G.Bhide and R.V.Damle.
Physica, Vol. 26, No. 7, 513-19 (July, 1960).

Dielectric hysteresis in manganese dioxide has been studie d.c. and a.c. fields as a function of temperature and the biassin field. At a temperature near 50°C., the dielectric constant is maximum and the loss factor tan δ is minimum. In the same temperature region, the saturation polarization, and the coerci field calculated from the hysteresis loop fall to a low value. Th results give further indication of the ferroelectric properties o manganese dioxide.

539.2 : 537.2 : 5

DIELECTRIC CONSTANT AND LOSSES OF ALKALI HALI CRYSTALS. See Abstr. 17900

539.2 : 537.2 : 545 : 621.315.6

INFRARED SPECTROSCOPY IN THE STUDY OF CAPACIT PAPER. See Abstr. 16396

539.2 : 537.2 : 621.315.

18094 FERROELECTRIC MATERIALS AND THEIR APPLICATIONS. A.Kremheller.
Sylvania Technol., Vol. 13, 42-8 (April, 1960).

A non-mathematical introduction to the theory of ferroelec ity. Applications of the high permittivity, non-linearity, and piezoelectricity of ferroelectrics are briefly discussed. J.B.

539.2 :

18095 THE EFFECT OF A CONSTANT ELECTRIC FIELD THE HYSTERESIS OF A FERROELECTRIC SALT. K.N.Karmen.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1671-5 (July, 1960). In Russi

Describes a resistance—capacity bridge with a c.r.t. for di ing polarization in a ferroelectric material under an applied ele static field. It is shown that such a field can affect the dielectri properties and relaxation times. A.E.I.Research Labora

539.2 :

18096 ELECTRICAL RELAXATION IN Ni-Zn FERRITE. L.Nowicki.
Acta phys. Polon., Vol. 19, No. 1, 85-92 (1960).

Measurements have been made of the frequency and tempe ture dependence of dielectric loss, and of the temperature depe dence of initial permeability, electrical conductivity of a polycrystalline ferrite $(ZnO)_{0.7}(NiO)_{0.5}(Fi_2O_3)_{0.3}$ prepared using stan techniques. The observed results indicate that the dielectric re xation observed is related to electron diffusion and not to an in geneous structure. S.A.A

539.2 :

18097 THE REVERSAL OF THE SPONTANEOUS POLARI TION IN GUANIDINE ALUMINIUM SULFATE HEXAHYDRATE [GASH]. E.Fatuzzo.
Helv. phys. Acta, Vol. 33, No. 5, 429-36 (1960).

The switching in GASH was studied in particular at high electr

The samples were subjected to electrical and thermal treat-
nd their switching was studied under different conditions. As
lt of these studies, it appears that at high fields the domain
otion time is longer than the nucleation time and hence cont-
e switching process.

539.2 : 537.2

98 THE QUESTION OF THE RELAXATIONAL POLARIZATION IN CRYSTALS WITH THE RUTILE AND PEROV-
STRUCTURE. I.Ts.Lyast.
kad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 170-6; Disc. 212-14
. In Russian.
1958 Moscow Dielectrics Conference" (see Abstr. 16003 of
The theory of polarization in ionic crystals due to relaxa-
defects is developed and applied to the perovskite lattice.
reckenridge mechanism (Abstr. 1231 of 1949), and electron-
ational mechanisms are also considered. R.F.S.Hearmon

539.2 : 537.2

099 ELECTRO-OPTIC KERR EFFECT AND POLARIZATION REVERSAL IN DEUTERIUM-DOPED ROCHELLE
. H.H.Wieder and D.A.Collins.
. Rev., Vol. 120, No. 3, 725-30 (Nov. 1, 1960).
Polarization reversal as a function of nucleation and growth of
ins in ferroelectric deuterium-doped Rochelle salt was inves-
d by means of the electro-optic Kerr effect. The results
ate that a phenomenological model based on statistical nuclea-
of domains in a plane including the ferroelectric axis followed
two-dimensional sidewise expansion of the domains, will ade-
ly account for the experimental observations for fields larger
50 V/cm. For lower fields, the process is controlled primar-
y the nucleation of new domains due to localized stresses
hinder the displacement of domain walls.

539.2 : 537.2

100 AGEING PROCESS IN TRIGLYCINE SULPHATE. J.Stankowska and J.Stankowski.
. Phys. Soc., Vol. 75, Pt 3, 455-6 (March, 1960).
Crystals of triglycine sulphate which have not been heat treated
bjected to electric fields for a considerable time can exhibit
le hysteresis loops; these are termed "old" samples. Normal
eresis is stated to be restored by treatment with high alter-
g electric fields or by heating above the Curie temperature.
time constant of the "rejuvenation" process in alternating fields
hanced in crystals doped with $CuSO_4$. The effects are attributed
purities diffusing to the domain walls and stabilizing anti-
llel domain configurations. L.E.Cross

539.2 : 537.2

3101 MEASUREMENTS OF THE DIELECTRIC CONSTANT OF $BaTiO_3$ SINGLE CRYSTALS IN THE PARAELECTRIC
ION AT X BAND. A.Lurio and E.Stern.
pl. Phys., Vol. 31, No. 10, 1805-9 (Oct., 1960).
The dielectric constant and loss tangent of single crystals of
iO_3 were measured as a function of temperature in the frequency
e of 8.2 to 12.4 kMc/s. The technique consisted of looking
ransmission resonances through the crystal whenever its
ness became λ/2 (where λ is the wavelength in the material).
n the Curie—Weiss behaviour of the dielectric constant in the
electric region, the A constant was determined to be
$\times 10^{-5}$ $\deg^{-1}$ C.

539.2 : 537.2

8102 THEORETICAL TREATMENT OF THE MOVEMENT OF 180° DOMAINS IN A $BaTiO_3$ SINGLE CRYSTAL. R.Abe.
hys. Soc. Japan, Vol. 14, No. 5, 633-42 (May, 1959).
A theoretical treatment is proposed for the movement of wedge-
ed 180° domains in a $BaTiO_3$ single crystal. It is proved that
experimental relations found by Merz can be explained
sfactorily by considering this new mechanism of the domain
ion. Further, a few quantitative examinations have been made
it is ascertained that there is no clear quantitative inconsistency
een the theoretical relations and Merz's experimental relations.

539.2 : 537.2

8103 EFFECT OF HYDROSTATIC PRESSURE ON THE DIELECTRIC PROPERTIES OF $BaTiO_3$.
imowski and J.Pietrzak.
c. Phys. Soc., Vol. 73, Pt 3, 456-9 (March, 1960).
The variation with hydrostatic pressure of the dielectric prop-
es of single crystals and ceramic $BaTiO_3$ was measured at
temperatures near the Curie point. The results agree with Devonshire's theory, and the value of the coefficient of volume electrostriction computed from the dielectric data for the single crystals agrees with the value deduced from the spontaneous polarization and volume change at the Curie temperature. L.E.Cross

539.2 : 537.2

18104 DIELECTRIC AFTER-EFFECT PHENOMENA IN BARIUM TITANATE CERAMICS. G.Bullinger..
Z. angew. Phys., Vol. 12, No. 9, 410-23 (Sept., 1960). In German.

Samples were charged for either 15 msec or for 5 min and the discharge current was then measured over the time range from 10^{-6} to 10^{2} sec. In this way two polarization effects were discovered, one with a very wide spread of short relaxation times of mean value between 10^{-6} and 10^{-3} sec and the other with a long relaxation time of more than 1 sec. By considering the variation of the after-effects with temperature and applied voltage, the short-time effects are attributed to the ferroelectric nature of the materials, while the long-time effects are explained on the basis of barrier layers caused by the semiconducting properties of the ceramic. K.W.Plessner

539.2 : 537.2

18105 THE PIEZO EFFECT IN ELECTRETS. A.N.Gubkin and V.S.Sorokin.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 24, No. 2, 246-52 (1960). In Russian.

"1958 Moscow Dielectrics Conference" (see Abstr. 16003 of 1960). The theory of the piezo effect in electrets is developed, with special reference to the influence of the gap between the electrodes and the specimen. It is concluded that there is a genuine effect, obtained with zero gap, and a "quasi" effect, obtained with a finite gap. Experiments with a number of titanate ceramics show that only barium titanate and a mixed strontium-bismuth titanate exhibit the genuine effect. The nature of the "quasi" effect is studied experimentally on the other ceramics. R.F.S.Hearmon

539.2 : 537.2

18106 THE MECHANISM OF SOME ELECTRETS. K.Antenen.
Z. angew. Math. Phys., Vol. 6, No. 6, 478-84 (Nov. 25, 1955). In German.

Probe measurements of the potential distribution within carnauba wax electret specimens are reported. The non-uniform distribution found provides proof of the author's contention that the heterocharge in electrets is due not to dipoles, but to ionic space-charge layers near the electrodes. Reasonable values for the ion concentration and mobility are derived. Electrets were also made from paraffin wax containing small amounts of impurities.
K.W.Plessner

539.2 : 537.2

18107 INVESTIGATION OF THE DELAYED DISCHARGE IN THIN SINGLE CRYSTALS OF NaCl. V.A.Kostrȳgin.
Fiz. tverdogo Tela, Vol. 2, No. 8, 1841-5 (Aug., 1960). In Russian.

The puncture of thin specimens of natural NaCl by an electric field applied with a rise time of 5×10^{-8} sec and an overshoot of 5-10% in voltage was studied with a high-speed oscillograph. Specimens were some 20μ thick. The puncture holes were examined microscopically. A.L.Mackay

539.2 : 537.2

18108 EFFECT OF IMPURITIES ON DIELECTRIC BREAKDOWN IN PLASTICIZED POLYVINYL CHLORIDE.
M.Ieda and U.Shinohara.
Mem. Fac. Engng Nagoya Univ., Vol. 11, No. 1-2, 121-9 (Nov., 1959).

A.C. and d.c. measurements were made on samples 0.05-0.25 mm thick and the effect of different amounts of stabilizer, filler, pigment and lubricant observed. The d.c. strength was 1.4-1.7 times the a.c. value. The electric strength was lowered by the pigments, but was unaltered or increased by the other additives. These changes were unrelated to the corresponding changes in volume resistivity, and may be connected with local field enhancement by the solid aggregates. I.D.L.Ball

539.2 : 537.2 : 621.315.611

18109 ON THE KINETICS OF PRE-BREAKDOWN PROCESSES IN SOLID INSULATION. K.W.Böer and U.Kümmel.
Elektrie, Vol. 14, No. 5, 148-52, with one page of photographs on inside back cover (May, 1960). In German.

Single crystals of cadmium sulphide were chosen for investigation of the processes of thermal and field-breakdown. The former process was followed by means of an electro-thermo-optical effect which enables the internal temperature and so the current distribution to be seen. A similar effect was used to show the internal potential distribution. Some previously unobserved effects were noticed. One point of interest was the similiarity of some of these effects with the processes in gas discharges. 19 references, many to earlier work by the authors on CdS. I.D.L.Ball

OPTICAL PROPERTIES OF SOLIDS

539.2 : 535

18110 THEORY OF THE DISPERSION AND ABSORPTION OF LIGHT IN CRYSTALS. V.L.Strizhevskii.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1806-15 (Aug., 1960). In Russian.

The interaction of a crystal with a monochromatic light wave is examined for the case in which the states permitted to the phototransitions form a continuous spectrum. The specific dipole moment of the dielectric polarization is calculated and formulae are given for the refractive index and the coefficient of light absorption. It is shown that the calculation of the absorption coefficient as a magnitude proportional to the probability of the phototransitions, does not always lead to a correct result. The theory is applied to the case of a molecular crystal in which excitons are formed and where the exciton—phonon interaction is not weak. The wave-functions and the energy levels for a molecular crystal with an arbitrary exciton—phonon coupling and with the assumption that the crystal is in thermal equilibrium have been found. A.L.Mackay

539.2 : 535

18111 THEORY OF CIRCULAR DICHROISM IN CRYSTALS. V.M.Agranovich.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1197-9 (June, 1960). In Russian.

A qualitative discussion is given of the causes of the strong absorption of one of two circularly polarized light waves. It is suggested that the phenomenon is connected with the processes of exciton decay via emission or absorption of phonons, the latter being unlikely at low temperatures. M.G.Priestley

539.2 : 535

18112 DIFFUSE REFLECTANCE MEASUREMENTS ON BULK URANIUM DIOXIDE. A.Companion and G.H.Winslow.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1043-5 (Nov., 1960).

Diffuse reflectance measurements were made on powdered uranium dioxide samples to which varying amounts of excess oxygen had been added. The principal purpose was to demonstrate that the optical constants and the description of the effects of excess oxygen on the absorption coefficient which were previously derived from studies of thin films of UO_2 apply also to bulk material. The reflectance method is rather insensitive for highly absorbing material, but it is believed that the objective was achieved. The characteristics of the reflectance method that tend to limit its easily useful application to material with small absorption coefficients are discussed briefly.

539.2 : 535 : 537.312

18113 OPTICAL AND PHOTOELECTRIC PROPERTIES OF THIN CdSe LAYERS. W.Wardzyński and W.Giriat.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 8, No. 5, 325-32 (1960).

Layers of CdSe between 0.5 and 10 μ thick were prepared by evaporation. The transmission and reflectivity were measured from 0.5 to 2.5 μ, and the refractive index and absorption constant determined as a function of wavelength. The refractive index is near 2.9 at wavelengths greater than 0.8 μ. The position of the absorption edge corresponds to an energy gap of 1.64 eV, with a temperature shift of 2.8×10^{-4} eV/deg C. The spectral distribution of photoconductivity depends to some extent on the layer thickness, and this is interpreted in terms of surface and volume recombination. C.Hilsum

539.2 : 535

18114 VARIATION OF THE PROPERTIES OF THIN GOLD FILMS AS A FUNCTION OF THEIR SPEED OF FORMATION. R.Philip.

J. Phys. Radium, Vol. 20, No. 8-9, 742-6 (Aug.-Sept., 1959). In French.

A study has been made of the influence of the speed of formation on the optical properties of evaporated gold films. Three series of evaporated layers have been prepared respectively with a spe of 0.8, 3 and 25 mμ min^{-1}. Evaporated films of similar series thickness of which varied from 0 to 70 mμ, have been prepare during two evaporations made as nearly as possible at the san speed. It was found that the optical properties vary a great de according to the speed of formation. Especially, the absorptio of a 60 mμ thick film may increase by a factor of 25 when the of formation is decreased from 25 to 0.8 mμ min^{-1}.

539.

18115 OPTICAL CONSTANTS AND PHASE VARIATIONS THIN GOLD FILMS. R.Philip.

Optica Acta, Vol. 7, No. 1, 47-52 (Jan., 1960). In French.

Measurements were made, on 18 films of gold of thicknes between 0.6 and 95 mμ, of the variations of phase of a light wa reflected normally on the metal in air (Δr) and in the quartz s strate on the metal (Δr'). These measurements, together with others previously reported of the reflection and transmission have made possible a determination of the optical constants of gold films by the method of Malé (Abstr. 3272 of 1954).

539.2

18116 OPTICAL CONSTANTS OF SILICON IN THE REGI 1 TO 10 eV. H.R.Philipp and E.A.Taft.

Phys. Rev., Vol. 120, No. 1, 37-8 (Oct. 1, 1960).

The reflectance, $|r(\lambda)|^2$, of single crystal silicon was me in the range 1 to 11.3 eV. The phase, $\theta(\lambda)$, was computed from data using the Kramers—Kronig relation between the real and imaginary parts of the complex function $\ln r = \ln |r| + i\theta$. Th optical constants, n and k, were then determined from the Fres reflectivity equation. The real part of the refractive index, n, a sharp maximum of magnitude 6.9 at 3.3 eV. The extinction c efficient, k, shows maxima of magnitude 3.1 at 3.5 eV and 5.1 a 4.3 eV; optical absorption above 3 eV is associated with the ons strong direct transitions. The results indicate that much usefu information, applicable to band structure calculations for both and germanium, could be obtained from limited reflectance stu (2 to 5 eV) on Ge--Si alloys.

539.2

18117 MEASUREMENT OF TRANSMISSION AND REFLE POWER OF ALKALI METALS IN THE FAR ULTR VIOLET. S.Robin and St.Robin.

J. Phys. Radium, Vol. 19, No. 11, 913-14 (Nov., 1958). In Fren

Thin films of sodium and potassium were prepared on fluo substrates, and their transmission and reflectivity measured f 1300 A to 3000 A. Sodium showed a transmission maximum fr 1600 A to 2000 A, and potassium from 2300 A to 2800 A.

C.Hi

539.2

18118 CHANGES IN THE INFRARED ABSORPTION OF C TAIN SEMICONDUCTING ADSORBATES ON ILLUMINATION WITH ULTRAVIOLET LIGHT. V.N.Filimonov

Optika i Spektrosk., Vol. 8, No. 2, 270-2 (Feb., 1960). In Russi

Describes studies of the effect on infrared absorption prod by ultraviolet illumination of WO_3 and SnO_2 in vacuo. The abso of WO_3 had a wide band in the region 0.3-0.9 eV. The absorptio maximum of SnO_2 lay approximately at 0.16 eV. If air or oxyge was let into the vacuum chamber where the samples were kept. transmission of WO_3 recovered quickly its former value, but in case of SnO_2 only a partial recovery of the original transmissio occurred. A.Tybule

539.2

18119 EXCITON AND MAGNETO-OPTICAL EFFECT IN STRAINED AND UNSTRAINED GERMANIUM. D.F.Edwards and V.J.Lazazzera.

Phys. Rev., Vol. 120, No. 2, 420-6 (Oct. 15, 1960).

Measurements were made of the direct transition magneto optical effect in strained and unstrained germanium at 77°K. T results indicate that the absorption peaks correspond to transit to exciton levels associated with each Landau level in qualitati agreement with the calculations of Loudon, and Howard and Hasegawa. A definitive experiment is suggested to test this the

539.2

18120 OPTICAL OBSERVATIONS OF SPIN—ORBIT INTE ACTION IN GERMANIUM. J.Tauc and E.Antončik.

Phys. Rev. Letters, Vol. 5, No. 6, 253-4 (Sept. 15, 1960).

The reflection spectrum of an etched single crystal of germanium was measured at 300°K in the visible region. A do

2.1 and 2.3 eV is interpreted in terms of energy-level g due to spin--orbit coupling. Similar double peaks were observed s, GaSb, InAs and InSb. J.N.Hodgson

539.2 : 535.33

21 OPTICAL PUMPING OF PARAMAGNETIC IONS IN SOLIDS. G.W.Series and M.J.Taylor.

's. Radium, Vol. 19, No. 11, 901-4 (Nov., 1958). In French. agnetic Resonance Symposium (see Abstr. [illegible] of 1950).
sential requirement in the alignment of atoms or ions by l pumping is that the pumping rate be at least comparable with te of relaxation from the ground states. Relaxation times of der of 10^{-6} sec have been measured for some paramagnetic n solids even at room temperature: the longest times are found ose ions whose ground states have no orbital angular momen- The better known features of the visible and ultraviolet ption spectra of these ions have oscillator strengths of the 10^{-6}, which is too small. Divalent europium ($^8S_{7/2}$) has an ption band in the region 3380 A whose oscillator strength is 6×10^{-3}, which might be sufficient for the attainment of a actory pumping rate. Divalent manganese ($^6S_{5/2}$) in zinc fluo- nosphor has an oscillator strength of order unity in the vacuum iolet.

539.2 : 535.33

122 LATTICE ANHARMONICITY AND OPTICAL ABSORPTION IN POLAR CRYSTALS. I. THE LINEAR N. A.A.Maradudin and R.F.Wallis.

Rev., Vol. 120, No. 2, 442-68 (Oct. 15, 1960).
A calculation of the optical absorption spectrum of an rmonic one-dimensional lattice of alternating positively and ively charged particles of different masses is carried out two different approaches: the recent theory of Born and g, and ordinary second-order time-dependent perturbation y. Closed-form expressions for the absorption spectrum are ned for both low and high temperatures. It is found that dary absorption peaks may be expected at frequencies other the dispersion frequency ω_d. At high temperatures the rption at ω_d varies as T^{-2} or T^{-3} depending on how certain nal averages are carried out. Predictions based on these ts are made regarding which features of the present spectra e expected to persist for three-dimensional lattices.

539.2 : 535.33

8123 INFLUENCE OF MECHANICAL TREATMENTS OF PURE CADMIUM SULPHIDE CRYSTALS ON THEIR CAL ABSORPTION SPECTRA AT LOW TEMPERATURES.
oss, M.Bancie-Grillot, E.Grillot and B.Razbirine.

Acad. Sci. (Paris), Vol. 250, No. 26, 4340-2 (June 27, 1960). ench.
The fine structure in the absorption edge of cadmium sulphide sured at low temperatures is destroyed by lapping and polishing e crystals and absorption in the latter case is increased at r wavelengths. The increase is attributed to dislocations and defects produced by mechanical working. G.F.J.Garlick

539.2 : 535.33

8124 ABSORPTION SPECTRA AND ZEEMAN EFFECT OF COPPER AND ZINC IMPURITIES IN GERMANIUM.
sher and H.Y.Fan.

s. Rev. Letters Vol. 5, No. 5, 195-7 (Sept. 1, 1960).
Measurements at liquid helium temperature of infrared absorp- spectra of germanium doped with Cu and Zn are described. The gy levels deduced from the absorption peaks are compared with e previously observed with Group III impurities. Under a field kG the absorption peaks were split and shifted. A compensated imen doped with Sb and Zn was used to obtain the spectrum of . Theoretical explanations of the observed spectra are sug- ed. J.N.Hodgson

539.2 : 535.33

8125 ABSORPTION SPECTRUM OF COPPER-COLOURED CUPROUS OXIDE. M.Hayashi.

hys. Soc. Japan, Vol. 14, No. 5, 681 (May, 1959).
By heating a cuprous oxide film 0.1 mm thick in a vacuum tric furnace maintained at 900° C, a copper-coloured specimen of ially reduced cuprous oxide was obtained. The absorption spec- n of the specimen revealed a new band at 576 mμ. A spectro- h of Hilger's constant deviation type was used with an incan- ent lamp as the light source.

539.2 : 535.33

18126 OPTICAL SPECTRA OF Eu^{2+} AND Gd^{3+} IN CaF_2. W.Low.

Nuovo Cimento, Vol. 17, No. 4, 607-8 (Aug. 16, 1960).

For Gd^{3+} sharp absorption lines are found around 32 500 cm^{-1} and weak lines at 37 000 cm^{-1} which are interpreted as transitions from $^8S_{7/2}$ to ^6P and ^6I levels respectively. For Eu^{2+} sharp bands are found at 24 200, 32 300, 35 400 and 37 000 cm^{-1} with diffuse and strong bands at,29 000 and 45 050 cm^{-1} (f = 0.01 and 0.03 respectively). The weak, sharp lines are probably the result of transitions $^8S_{7/2}$ to ^6P ^6I and ^6D levels the strong but diffuse bands being associated with transitions to the configuration $4f^65d$. G.F.J.Garlick

539.2 : 535.33

18127 INFRARED ABSORPTION WAVELENGTHS FOR SOLID LiH AND LiD. W.B.Zimmerman and D.J.Montgomery.

Phys. Rev., Vol. 120, No. 2, 405 (Oct. 15, 1960).

The infrared absorption spectrum of thin films of LiH and LiD was obtained at room temperature for the region 12.5-25μ. The primary feature of the spectrum is a broad but definite absorption peak which occurs at 17.0μ for LiH and at 22.4μ for LiD. The observed ratio of the wavelengths is 1.32 ± 0.02, in excellent accord with the ratio of the square root of the reduced masses, 1.33. This agreement is a confirmation of the elementary Born theory of lattice vibrations.

539.2 : 535.33

18128 INFRA-RED ABSORPTION BANDS IN α-QUARTZ IN THE 3 μ-REGION. A.Kats and Y.Haven.

Phys. Chem. Glasses, Vol. 1, No. 3, 99-102 (June, 1960).

From deuterium exchange experiments it is shown that in the 3 μ region the absorption bands at 3311 cm^{-1}, 3371 cm^{-1} and 3435 cm^{-1} in α-quartz (among several more) are related to OH vibrations, whereas the bands 3204 cm^{-1}, 3300 cm^{-1} and 3392 cm^{-1} are overtones or combination bands of the quartz vibration spectrum.

539.2 : 535.33

18129 THE ABSORPTION OF INFRARED RADIATION BY ELECTRONS IN N-TYPE SILICON. V.A.Yakovlev.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1624-8 (July, 1960). In Russian.

A theoretical calculation is made of the absorption by the scattering of electrons at oscillated atoms. The mechanism of scattering at lattice defects is excluded. A.L.Mackay

539.2 : 535.33

18130 PRELIMINARY ANALYSIS OF U^{4+} ION SPECTRA IN CRYSTALS. R.A.Satten, D.Young and D.M Gruen.

J. chem. Phys., Vol. 33, No. 4, 1140-51 (Oct., 1960).

An analysis of a number of features of the absorption spectra of U^{4+} ions in crystals is given. Absorption spectra of crystals of the compounds Cs_2UCl_6, and $[N(CH_3)_4]_2\ UCl_6$, and to a lesser extent $[N(C_2H_5)_4]_2\ UCl_6$ were studied at room temperature, liquid N_2 and liquid He temperatures. The visible spectrum is essentially entirely vibronic. Pure electronic transitions are absent or very weak in thick crystals in agreement with a model of electric dipole transitions within the $5\ f^2$ shell at an equilibrium site of inversion symmetry. This is believed to be the first demonstrated case of an essentially purely vibronic spectrum reported for rare earth or actinide salts. The three "ungerade" frequencies of the $UCl_6^{=}$ complex are coupled to the electronic frequencies and are determined by their appearance with the same frequency of superposition in all three salts as well as by being the most intense of the vibronic lines in every group in which they appear. Other lattice modes and internal frequencies of the tetramethylammonium ion are also found to be superimposed. The weak pure electronic transitions are fairly sharp, an indication that there is still considerable shielding in the $5\ f^n$ electronic states even though this shielding is less than in $4\ f^n$ states. The independence of superimposed vibration frequencies on $5\ f^2$ electronic states indicates the fact that the 5 f states do not contribute much to the binding. The similarity in the spectra of the three salts studied is due to the fact that the nearest-neighbour Cl^- ions are the principal origin of the crystalline field in contrast to the rare earths, wherein this type of similarity is due to the fact that the crystalline field is small and each group of lines represents a multiplet level of the free ion. Evidence is presented that the crystalline field splitting is larger than hitherto believed and is the same order of magnitude as the spin—orbit interaction. Methods of attacking the problem of the experimental classification and calculation of energy levels in the situation in which three major interaction are of comparable size are discussed.

539.2 : 535.33

18131 ELECTRONIC ABSORPTION SPECTRUM OF DIPHENYLENE IN SUBSTITUTIONAL SOLID—SOLID SOLUTION.

R.M.Hochstrasser.

J. chem. Phys., Vol. 33, No. 3, 950-1 (Sept., 1960).

The polarized electronic spectrum of diphenylene in a single crystal of naphthalene has been studied. The polarization ratios found indicate that the order of the states in diphenylene is not the same as in naphthalene but parallels that found for anthracene. This result is at variance with Clar's assignment.

W.J.Orville-Thomas

539.2 : 535.33

18132 POLARIZED ABSORPTION AND FLUORESCENCE SPECTRA OF 2,6-DIMETHYLNAPHTHALENE AT DIFFERENT TEMPERATURES.

A.Zmerli and H.Poulet.

J. chem. Phys., Vol. 33, No. 4, 1177-83 (Oct., 1960).

2,6-Dimethylnaphthalene melted between two silica disks crystallizes parallel to its cleavage plane σ_{ab}. The polarized absorption spectra obtained at 300°K, 77°K, 20°K, and 4°K show no variation in the relative intensities of the a and b spectra, suggesting that there is no change of crystal phase between 300°K and 4°K. At 4°K three vibrational progressions were found in the a spectrum and only two in the b spectrum. The first bands of the strongest a and b progressions, i.e., the bands at 30 740 cm^{-1} and 30 675 cm^{-1}, respectively, are interpreted as transitions to the exciton levels. The weak progression starting at 30 650 cm^{-1} appears in both polarization directions. The 30 634 cm^{-1} series, which is also weak, is a polarized. The origin of these weak bands is discussed. The polarized fluorescence spectra have been obtained at 20°K and interpreted. Possible locations of the c exciton transition are mentioned. The comparison of these experimental results and the theoretical predictions leads to the conclusion that the dipolar moment of the first transition of 2,5-dimethylnaphthalene is close to the short axis of the naphthalene ring.

539.2 : 535.37

18133 A VIBRATIONAL EFFECT ON THE POLARIZATION OF MOLECULAR CRYSTAL FLUORESCENCE.

E.G.McRae.

J. chem. Phys., Vol. 33, No. 3, 932-3 (Sept., 1960).

The degree of polarization of fluorescence of molecular crystals is usually assumed to vary with temperature in a way dependent on a Boltzmann distribution of electronic energies among the upper states in absorption. The effect of specific intramolecular interactions on the degree of polarization is determined for anthracene. Good agreement is obtained with experimental data for the first three vibrational peaks in the anthracene fluorescence showing that the vibrations play an important part in fluorescence polarization.

G.F.J.Garlick

539.2 : 535.37 : 532.7

18134 MEASUREMENT OF LUMINESCENCE DECAY IN THE REGION 10^{-8}-10^{-4} SEC FOR OPTICAL EXCITATION.

H.Blume.

Z. Naturforsch. Vol. 15a, No. 8, 743 (Aug., 1960). In German.

Running waves at 8 Mc/s in a liquid cell are modulated at 500 kc/s. A multi-slit system with a spacing corresponding to the wave-group spacing in the cell then gives 500 kc/s modulated fringes (50% modulation). The first order fringes are selected to excite luminescence and their phase compared with that of the latter using a double beam oscilloscope. Wide slits can be used and thus high intensity excitation is possible with this system.

G.F.J.Garlick

539.2 : 535.37

18135 A MODEL FOR THE COLOUR AND LUMINESCENCE CENTRES IN QUARTZ.

E.N.Batrak.

Kristallografiya, Vol. 3, No. 5, 626-7 (1958). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 3, No. 5, 633-4 (Dec., 1959).

The model involves an Al ion being replaced by a Si ion, causing an activator as in phosphors. The charge deficiency thus introduced is compensated by an alkali metal ion giving rise to electron traps. After excitation from the activator or the valence band and subsequent trapping, an electron can be excited to a higher level without reaching the conduction band. Such a transition would result in a visible absorption band. Thermal emptying of the trapping state is followed by a transition to an excited level of the activator and then to the ground state.

I.Cooke

539.2 :

18136 FACTORS INFLUENCING THE LUMINESCENT EMISSION STATES OF THE RARE EARTHS.

L.G.Van Uitert.

J. Electrochem. Soc., Vol. 107, No. 10, 803-6 (Oct., 1960).

The number of electronic states from which luminescent e
sion by rare earth ions can be observed is dependent on the ex
which the host lattice perturbs their f-orbital electrons. Amon
others, perturbing influences may stem from the following sou
(a) Coulombic affinities of the ions or molecules surrounding t
rare earth ions for the electrons they share with the latter; (b)
centration effects, i.e. exchange coupling; (c) thermal effects,
vibronic interactions. Results obtained on metal organic comp
hydrates, fluorides, and tungstates are compared. The effects
emission of the rare earth ion concentration in the tungstates a
compared for europium, terbium, dysprosium, and erbium at r
temperature, and the influences of thermally excited interactio
the emission of erbium are demonstrated.

539.2 :

18137 THE NATURE OF ELEMENTARY OSCILLATORS C THE URANIUM ION.

P.P.Feofilov.

Optika i Spektrosk., Vol. 8, No. 6, 824-7 (June, 1960). In Russ

The nature of the elementary oscillators of the hexavalent
uranium ion was deduced from an investigation of the polariza
of the bright green luminescence of LiF:U crystals. The resul
indicated the presence of both magnetic and electric dipole em

A.Tybul

539.2 :

18138 SOME LUMINESCENCE PHENOMENA IN URANYL NITRATE.

D.D.Pant and H.D.Bist.

J.sci. industr. Res., Vol. 19B, No. 9, 360-1 (Sept., 1960).

Scintillation and luminescence phenomena in uranyl nitrate
hexahydrate, investigated by keeping a single crystal or a mas
of crystals in tubes under low pressure, appear to be connecte
with the pyroelectric property of the salt. Interesting differen
have been observed in the characteristic luminescence and flu
rescence spectra of powdered samples and crystals of uranyl nitrate under pressure, and of uranyl nitrate hexahydrate and hexadeuterate and their slowly cooled solutions.

539.2 : 5

18139 THE EFFECTS OF INFRARED RADIATION ON TRAPPED ELECTRONS IN EXCITED ZnS-PHOSPH

B.Kramer and M.Schön.

Z. Phys., Vol. 160, No. 2, 145-8 (1960).

By means of rise curves the number of trapped electrons c
determined. The effect of infrared irradiation added simultane
to u.v. excitation is that of quenching; in addition the number of
occupied traps (n_t) is found to be considerably reduced, approxi
mately in the same ratio as the reduction of light. Since the fre
electron concentration (n) is also quenched by the addition of inf
red to ultraviolet, there is some difficulty with the relationship:
light = constant × n × n_t.

539.2 : 5

18140 CHARACTERISTICS OF LUMINESCENCE OF ORTH DISUBSTITUTED AROMATIC HYDROCARBONS. II FLUORESCENCE AND ABSORPTION SPECTRA OF SOME CARBOXYLIC ACIDS.

Yu.V.Naboikin, B.A.Zadorozhnÿi and E.N.Pavlova.

Optika i Spektrosk., Vol. 8, No. 5, 657-62 (May, 1960). In Russ

For Pts I and II see Optika i Spektrosk., Vol. 6, No. 3, 366
(March); No. 4, 492 (April, 1959). Deals with the effect of ioniz
of internal hydrogen bonds and of dimer formation on the electr
absorption spectra and the fluorescence spectra of some substit
carboxylic acids.

A.Tybule

539.2 : 5

18141 PHOSPHORESCENCE LIFETIME OF BENZENE. A INTERMOLECULAR HEAVY-ATOM EFFECT, A DEUTERIUM EFFECT, AND A TEMPERATURE EFFECT.

M.R.Wright, R.P.Frosch and G.W.Robinson.

J. chem. Phys., Vol. 33, No. 3, 934-5 (Sept., 1960).

Experiments with C_6H_6 and C_6D_6 in solid CH_4, A, Kr, and Xe
at 4.2°K show that phosphorescence is slightly affected by deute
in low molecular weight solvents. Phosphorescence is markedl
affected by intermolecular spin-orbit perturbation in the case o

ntramolecular perturbation. The residual deuterium effect
ene for low molecular weight solvents seems to be a result
-radiative processes from the zero-point vibrational state
due to intramolecular phosphorescence processes.

G.F.J.Garlick

539.2 : 535.37

42 PHOSPHORESCENCE MECHANISMS. I. APPROACH AND GENERAL ANALYSIS. C.Billington.

ev., Vol. 120, No. 3, 697-701 (Nov. 1, 1960).
new technique is described for the study of decay mechanisms
sphors. When a phosphor is excited by radiation whose
ty is modulated to a depth less than 10%, the modulation of the
on intensity has negligible harmonic content. Quantitative
risons of these two modulated signals, if of sufficient
cy and range, result in qualitative distinctions between
nt basic mechanisms, and the possibility of subsequent
tative analysis. In particular monomolecular and bimolecular
sses are unequivocally distinguished.

539.2 : 535.37

43 PHOSPHORESCENCE MECHANISMS. II. DESCRIPTION OF PHOSPHOROMETER. C.Billington.

Rev., Vol. 120, No. 3, 702-7 (Nov. 1, 1960).
he functions of the phosphorometer are (i) to excite the
hor under test with ultraviolet radiation whose intensity is
ated sinusoidally, (ii) to measure the modulation frequency,
i) to sample the excitation and emission intensities, and to
t from their modulated components the in-phase attenuation
between them. The Hg arc source is current-modulated and
zed by optical feedback over the range 3 to 30 000 c/s. The
ge intensity of both excitation and emission is used to control
nsitivity of their respective photodetectors so that the
ation signals are always referred to the same datum. Both
s are passed in turn through a homodyne detector whose
is adjusted to identify with the excitation modulation. The
ase attenuation factor which is the ratio of the homodyne outputs
ermined potentiometrically with a probable error of about 0.002.

539.2 : 535.37

8144 PHOSPHORESCENCE MECHANISMS. III. METHOD OF ANALYSIS. C.Billington.

Rev., Vol. 120, No. 3, 708-9 (Nov. 1, 1960).
he method of deconvolution is discussed for the case in which
horescence is distributed between a number of concurrent
onents with different rate constants. The resolution of the
d is deduced quantitatively from the known r.m.s. difference of
paratus.

539.2 : 535.37

8145 PHOSPHORESCENCE MECHANISMS. IV. DECAY RATE SPECTRA OF RUBY, URANIUM GLASS, AND CTIVATED ZINC SULFIDE. C.Billington.

Rev., Vol. 120, No. 3, 710-14 (Nov. 1, 1960).
The samples were studied by means of the phosphorometer in a
amme of measurement and analysis which included variation of
erature and average exciting intensity. It was not possible to
ify any laws of temperature dependence, but there is strong
nce that part of the phosphorescence mechanisms operating in
nS:Mn sample involves recombination.

539.2 : 535.37 : 539.1.07 : 621.387.464

3146 THE PROCESSES INVOLVED IN THE IMPROVEMENT OF PLASTIC SCINTILLATORS.

Brown, M.Furst and H.Kallman.
ear Electronics Conference, Paris, 1958. Vol. I. (see Abstr.
9 of 1960) p.15-26.
The intensities of fluorescence in several materials were
sured. The bulk solvents were polystyrene (PS) and poly-
ylmethacrylate (PMMA). The latter is structurally similar to
d solvents known to be inefficient, and was used to investigate
ossibility of using methods of enhancement successfully applied
uids. PS was found to be a moderate solvent for energy
sfer and, as in the case of liquid solvents, the use of an inter-
iate solvent such as naphthalene increases the efficiency. The
esses involved are not yet fully understood. With PMMA, the
mum intensities were smaller but were increased to the same
r as for PS by the use of naphthalene. The naphthalene
entration required (0.8 M) was several times higher than in PS.

W.G.Stripp

539.2 : 535.37

18147 MECHANISM OF THE SCINTILLATION PHENOMENON IN ALKALI HALIDE PHOSPHORS. W.J.Van Sciver.

Nuclear Electronics Conference, Paris, 1958. Vol. I. (see Abstr. 12719 of 1960) p.37-43.

Experiments to determine the nature of the luminescent centres in NaI:Tl and the mechanism of energy transfer from the crystal matrix to these centres are described. On the assumption that, in the case of u.v. excited fluorescences in KCl:Tl, the luminescent centre is formed by substitution of a Tl^+ ion for a K^+ ion, the conclusion is reached that the Tl^+ ion is similarly responsible, by substitution for an Na^+ ion, in NaI:Tl. Excitons, electrons and holes are likely candidates as energy carriers.

W.G.Stripp

539.2 : 535.37

18148 EFFECTS OF ALTERNATING AND CONTINUOUS ELECTRIC FIELDS ON THE LUMINESCENCE OF CERTAIN SULPHIDES OF ZINC EXCITED BY α-RAYS.

A.Coche and R.Henck.

J. Phys. Radium, Vol. 20, No. 10, 827-9 (Oct., 1959). In French.

The α-particle luminescence of ZnCdS:Mn is enhanced by an a.c. field if the Mn content is 1% or 0.1%, but decreased for 0.01% Mn. Increase of field causes roughly linear enhancement of the yellow emission band, and decrease of the blue band if present. Under a d.c. field time effects are observed, and high Mn content leads to enhancement while low Mn leads to quenching. "Memory" effects are described.

S.T.Henderson

539.2 : 535.37 : 621.385.832

18149 INFLUENCE OF BINDERS UPON THE SURFACE BRIGHTNESS OF CATHODE-RAY TUBE SCREENS. III.

I.Hangos, H.Toperczer and G.Pozsgay.

Acta tech. Hungar., Vol. 29, No. 1-2, 47-55 (1960).

A study was made of screens of Zn_2SiO_4:Mn and ZnS:Ag, using Sr^{90} to estimate the Sr content of the binder layer, and the attenuation of cathode rays to estimate the layer thickness. Screen brightness depends on these variables, which themselves depend on the concentrations of binder (K silicate) and coagulator (Sr nitrate). For earlier work see Abstr. 2983 and 6873 of 1958.

S.T.Henderson

539.2 : 535.37 : 539.1.07

18150 SOME CONSIDERATIONS ON LUMINESCENT FIBER CHAMBERS AND INTENSIFIER SCREENS.

L.Reiffel and N.S.Kapany.

Rev. sci. Instrum., Vol. 31, No. 10, 1136-42 (Oct., 1960).

Factors affecting the performance of filamentary scintillators are considered. Experimental data on light attenuation for both plastic scintillator filaments and thin-wall glass tubing liquid scintillators are presented. A theoretical interpretation which satisfactorily accounts for the performance of luminescent filaments in terms of bulk properties and surface reflection losses is given and permits quantitative evaluation of surface losses for various materials. While plastic scintillator fibres are mechanically convenient, it is suggested that liquid-filled fibres will prove more consistent and stable in their properties. Comments on the utility of arrays of fibres as particle track imaging devices and as image intensifier screens are included.

539.2 : 535.37

18151 ELECTROLUMINESCENCE — A DISORDER PHENOMENON. D.W.G.Ballentyne.

J. Electrochem. Soc., Vol. 107, No. 10, 807-10 (Oct., 1960).

In general, electroluminescence is considered to occur at a junction between a semiconducting crystal and a metal or electron rich material. The present work indicates that electroluminescence only occurs in zinc sulphide powders containing both sphalerite and wurtzite. This observation suggests that electroluminescence is a disorder phenomenon associated with stacking faults in the crystal.

539.2 : 535.37

18152 THE ELECTROLUMINESCENT PANEL IN AN ULTRASONIC FIELD. P.Greguss and J.Weissburg.

Acustica, Vol. 9, No. 3, 183-4 (1959).

When a panel normally of blue-green electroluminescence is exposed to ultrasound, the affected parts show a persistent yellow electroluminescence. This is probably due, not to the ZnS phosphor, but to $BaTiO_3$ or other material of high dielectric constant which in this case is mixed with the phosphor.

S.T.Henderson

539.2 : 535.37 : 621.383.2

18153 THE PREPARATION OF ELECTROLUMINESCENT PANELS. G.Siddall.

Vacuum, Vol. 7-8, 61-71 (1957-58: publ. April, 1959).

Gives complete details of the manufacture of electroluminescent light sources, using vacuum deposited films for the conducting electrodes. Commencing with a glass base, which is made electrically conductive by sputtering a transparent cadmium oxide film, the phosphor is mixed with a resin-based lacquer and sprayed on the semiconducting oxide film. This is followed by a second layer of insulating material upon which the top electrode of aluminium may be deposited by evaporation in vacuum. Upon applying an alternating field between the two conducting electrodes, the phosphor emits light through the transparent oxide film. Three power supplies have been made to supply alternating current at suitable voltage and frequency, and full details are given.

539.2 : 535.37

18154 THERMAL EMISSION AND DECOLORIZATION IN X-IRRADIATED QUARTZ. E.N.Batrak.

Kristallografiya, Vol. 3, No. 5, 627-9 (1958). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 3, No. 5, 635-6 (Dec., 1959).

A thermoluminescence technique was used to study the effect of Na and Li ions in X-irradiated quartz. The thermal emission was also examined while decolorization was taking place. The coincidence of the maximum of the rate of decolorization and the thermal emission bands led to the suggestion that the absorption bands at 450 and 630 mμ are caused by electrons trapped at Li and Na ions.
I.Cooke

539.2 : 535.37

18155 EFFECTS OF ILLUMINATION UPON SODIUM CHLORIDE THERMOLUMINESCENCE. A.E.Stoddard.

Phys. Rev., Vol. 120, No. 1, 114-17 (Oct. 1, 1960).

Illumination of a sodium chloride crystal at liquid nitrogen temperature after X-ray irradiation at a higher temperature or higher temperature annealing has two effects upon its thermoluminescence: (a) glow peaks stable at the temperature of X-ray irradiation or annealing are diminished in intensity; (b) missing glow peaks, unstable at the temperature of X-ray irradiation or annealing, reappear in the glow curve. Both effects are greatest for illumination in the F-band. The results are not consistent with existing models of the thermoluminescence process.

MAGNETIC PROPERTIES OF SOLIDS

539.2 : 538.2

18156 THEORY OF THE MAGNETIC SUSCEPTIBILITY OF CRYSTALS. C.P.Enz.

Helv. phys. Acta, Vol. 33, No. 2, 89-114 (1960).

The foundations of a new theoretical treatment of the field independent magnetic susceptibility of electrons in a periodic potential are described. The susceptibility is obtained by perturbation theory using the Bloch representation. The connection between this and previous methods is described.
D.J.Oliver

539.2 : 538.2

18157 TEMPERATURE DEPENDENCE OF MAGNETIC SUSCEPTIBILITY. C.P.Enz.

Helv. phys. Acta, Vol. 33, No. 2, 115-22 (1960).

Some semiconductors exhibit a diamagnetic susceptibility of the form $\chi_{exp} \cong -a + bT$ $(b > 0)$ at low temperatures. The previous theory (see preceding abstract) is extended to include the electron—phonon interaction and it is suggested that the result may account for the temperature dependence of χ_{exp}.
D.J.Oliver

539.2 : 538.2 : 536.48

PROPERTIES OF SOME MAGNETIC SUPERCONDUCTORS. See Abstr. 16956

539.2 : 538.2 : 537.32

THE GALVOMAGNETIC AND THERMOMAGNETIC EFFECTS OF MONOVALENT METALS. See Abstr. 18077

539.2 :

18158 ANISOTROPY OF THE MAGNETIC SUSCEPTIBIL OF GALLIUM. T.Pankey, Jr.

J. appl. Phys., Vol. 31, No. 10, 1802-4 (Oct., 1960).

The bulk magnetic susceptibilities of single gallium cryst and polycrystalline gallium spheres were measured at 25°C. following anisotropic diamagnetic susceptibilities were found: a axis $(-0.119 \pm 0.001) \times 10^{-6}$ emu/g, b axis $(-0.416 \pm 0.002) \times$ $\times 10^{-6}$ emu/g, and c axis (-0.229 ± 0.001) emu/g. The suscept of the polycrystalline spheres, assumed to be the average valu the bulk susceptibility of gallium, was $(-0.257 \pm 0.003) \times 10^{-6}$ at 25°C, and $(-0.299 \pm 0\ 003) \times 10^{-6}$ emu/g at −196°C. The susceptibility of liquid gallium was $(0.0031 \pm 0.001) \times 10^{-6}$ emu 30°C and 100°C. Rotational diagrams of the susceptibilities in three orthogonal planes of the unit cell were not sinusoidal. T anisotropy in the single crystals was presumably caused by th partial overlap of Brillouin zone boundaries by the Fermi-ene surface. The large change in susceptibility associated with the change in state was attributed to the absence of effective mass influence in the liquid state.

539.2 :

18159 ON THE DIAMAGNETISM OF GRAPHITE. I. ENE LEVELS OF π-ELECTRONS. H.Sato.

J. Phys. Soc. Japan, Vol. 14, No. 5, 609-17 (May, 1959).

The energy levels of the conduction electrons in graphite, the presence of a magnetic field, are calculated by the method tight binding approximation, taking into account the effect of ba band transitions which is not included in the Landau—Peierls t ment. The present theory is a natural extension of the Lutting Kohn and McClure theories for the band structure of graphite. relation to the diamagnetic susceptibility is discussed.

539.2 :

18160 STATISTICAL MECHANICS OF A DISORDERED MAGNETIC LATTICE. J.Seiden.

C.R.Acad. Sci. (Paris), Vol. 250, No. 3, 485-7 (Jan. 18, 1960). In French.

The magnetic susceptibility and Curie point of a disordere lattice are calculated without the Ising approximation used in a previous note (Abstr. 6217 of 1960). Good agreement is report with the experimental results of Matthias, Suhl and Corenzwit (Abstr. 7980 of 1958) on solid solutions of gadolinium in a superconductor.
D.M.Edw

539.2 :

18161 STATISTICAL MECHANICS OF A DISORDERED MA NETIC LATTICE AT LOW TEMPERATURES.

J.Seiden.

C.R. Acad. Sci. (Paris), Vol. 250, No. 18, 3006-8 (May 2, 1960). In French.

539.2 :

18162 A SHORT NOTE ON THE CRYSTALLINE ELECTRI FIELDS IN HYDRATED Co^{2+} SALTS.

A.S.Chakravarty and R.Chatterjee.

Indian J. Phys., Vol. 33, No. 12, 531-3 (Dec., 1959).

Gives a preliminary account of the theory of the susceptibi and anisotropy of hydrated Co^{2+} salts using Abragam and Pryce Hamiltonian (Abstr. 2821, 5577 of 1951). It is seen that the exp mental anisotropies and susceptibilities can be well fitted with theory on the assumption that the anisotropic crystalline electr field changes quite appreciably from salt to salt and with tempe ture.

539.2 :

18163 STATE DIAGRAM AND MAGNETIC SUSCEPTIBILIT OF FERRO-CALCIUM SILICATES.

D.M.Chizhikov and V.P.Schastlivÿi.

Fiz. tverdogo Tela, Vol. 2, No. 6, 1264-8 (June, 1960). In Russi

The magnetic susceptibilities of oxide melts of the system $FeO-SiO_2-CaO$ are measured in relation to temperature and c position. It is shown that maxima and discontinuities on the iso therms of magnetic susceptibility represent transitions of the m from one phase state to another. At temperatures above the Cu point the melts are paramagnetic. The absolute value of the sus ceptibility is found to depend directly on the proportion of FeO melt. There is no change in susceptibility when solidification o liquefaction occurs.
N.

539.2 : 538.2

4 **THE MAGNETIC SUSCEPTIBILITY OF FERROUS FLUOSILICATE AT LOW TEMPERATURES.**

ckson.
lag. (Eighth Ser.), Vol. 4, 269-72 (Feb., 1959).
servations of $\chi_{\parallel}$ and $\chi_{\perp}$ between 1.6° and 77° K show that the
ion of the octahedron of water molecules surrounding the
ion in the unit cell is a squashing along a 3-fold axis.

E.P.Wohlfarth

539.2 : 538.2

65 **MAGNETIC SUSCEPTIBILITY OF TETRAGONAL TITANIUM DIOXIDE.**

nftle, T.Pankey and F.A.Grant.
Rev., Vol. 120, No. 3, 820-5 (Nov. 1, 1960).
areful measurements were made of the magnetic suscept-
of the rutile and anatase crystalline forms of titanium
e. The magnetic susceptibility of a single crystal of high-
rutile was found to be (0.067 ± 0.0015) × 10^{-6} e.m.u. per gram,
is temperature-independent from 55° to 372° K. Difficulty was
ntered in obtaining a good value of the magnetic susceptibility
tase because of impurities. However, a value of 0.02 × 10^{-6}
per gram was obtained as a maximum value for anatase powder.
ussion is given for the different values obtained for anatase
tile.

539.2 : 538.2

166 **THE MAGNETIC SUSCEPTIBILITY OF SOLID SOLUTIONS OF VANADIUM DIOXIDE IN TITANIUM**
DE. S.M.Ariya and G.Grossmann.
verdogo Tela, Vol. 2, No. 6, 1283-6 (June, 1960). In Russian.
he results of measurements of the magnetic susceptibility of
solutions of VO_2 in TiO_2, of various compositions, over the
rature range from 25° to 90° C are given. These substances
ramagnetic, and the two constants of the Curie—Weiss law
re VO_2, pure TiO_2 and two solutions containing 10% and 20%
cular) of VO_2, respectively, are calculated. Graphs show how
sceptibility varies (1) with temperature for solutions of
is constant composition, and (2) with composition at various
ratures. The above law is obeyed.

N.Davy

539.2 : 538.2

167 **STUDIES ON THE MAGNETIC SUSCEPTIBILITY OF SOME V^{3+} ALUMS AND Ti^{3+} CAESIUM ALUM IN THE**
GE 300° K TO 100° K.

utta-Roy, A.S.Chakravarty and A.Bose.
n J. Phys., Vol. 133, No. 11, 483-97 (Nov., 1959).
Describes the details of the difficult process of obtaining large
e crystals of four alums of V^{3+} and one of Ti^{3+} and the measu-
nts of their magnetic susceptibility in the range 300° to 100° K.
ne salts are apparently found to obey the Curie law very well.
theoretical analysis of the data on modern lines shows that in
e salts variations of the effective mean moment square P_f^2
temperature are to be expected owing to (1) change in the tri-
crystalline splitting with temperature and (2) change in the
mann distribution of the population of the different close lying
s with temperature. Evidently, the variations in the liquid air
e are not sufficient to produce a deviation from linearity of
T curves, though deviations in their slopes against T axis as
the intercepts with P_f^2 axis from the theoretical expectations
bserved. In T_i^{3+} the change in crystalline field with tempe-
e is considerable at very low temperatures. In V^{3+} alums
is also an appreciable change in crystalline fields from one
o another.

539.2 : 538.2

168 **MAGNETIC SUSCEPTIBILITY OF p-TYPE Ge.** R.Bowers and Y.Yafet.

. Rev., Vol. 120, No. 1, 62-6 (Oct. 1, 1960).
The susceptibility was measured for a range of extrinsic carrier
ities extending from 5 × 10^{17} to 5 × 10^{20} cm^{-3}. Measurements
made in the temperature range 300° to 1.3° K. The degenerate
susceptibility was determined from the data. At the lower
ier densities, the data depart appreciably from the Landau--
rls value; above 10^{20} cm^{-3} the data exhibit features due to the
lation of the split-off band. From the experimental results, it
timated that the Fermi level touches the minimum of the split-
and at a carrier density of 1.3 × 10^{20} cm^{-3}. A qualitative dis-
ion is given of the factors determining the susceptibility including
degeneracy and spin—orbit coupling; a detailed quantitative
sis is not attempted.

539.2 : 538.2

18169 **PARAMAGNETIC BEHAVIOR OF POLYCRYSTALLINE SAMARIUM FROM 300° K TO 1400° K.** S.Arajs.

Phys. Rev., Vol. 120, No. 3, 756-9 (Nov. 1, 1960).

The paramagnetic susceptibility was measured as a function of temperature between 300 and 1400° K. The high-temperature phase transformations do not prodace noticeable discontinuities in the magnetic sysceptibility, indicating that the interactions between the samarium ions are small at these temperatures. The experimental results are compared with the Van Vleck theory of paramagnetism. It appears that the energy levels of Sm^{3+} in metallic samarium differ more from those predicted by the Russell—Saunders coupling than has been realized before. Collective magnetic behaviours resulting from the interaction between the samarium ions are briefly discussed in the light of some recent low-temperature investigations.

539.2 : 538.2

18170 **ANISOTROPY ENERGY IN THE PARAMAGNETIC REGION OF IRON SULFIDE.** M.Murakami.

Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 2, 62-6 (Aug., 1959).

A remarkable anistropy has been observed in the paramagnetic region of temperature above the Néel point T_N. This anisotropy energy was estimated assuming that it stems from the anisotropic crystalline field, and its value was obtained as

$$K/N = -5.34(M/M_0)^2 \text{ cm}^{-1} \text{ per one } Fe^{++} \text{ ion.}$$

539.2 : 538.2 : 621.318.122

18171 **PROCEEDINGS OF THE FERROMAGNETISM WORKING PARTY 1959** [Berichte der Arbeitsgemeinschaft Ferromagnetismus 1959].

Düsseldorf: Verlag Stahleisen (1959) 270 pp. In German.

The meeting was held in Berlin, in October, 1959, under the auspices of the Deutsche Gesellschaft für Metallkunde, the Werkstoffausschuss of the Verein Deutscher Eisenhüttenleute and the Verband Deutscher Physikalischer Gesellschaften. The proceedings contain 36 articles. Abstracts will be found in this or succeeding issues of "Physics Abstracts".

539.2 : 538.2

18172 **STATISTICAL MECHANICAL THEORY OF FERROMAGNETISM. HIGH DENSITY BEHAVIOR.** R.Brout.

Phys. Rev., Vol. 118, No. 4, 1009-19 (May 15, 1960).

For previous work, see Abstr. 674 of 1960. The partition function of the Ising model of ferromagnetism is examined in the limit of high density in the anticipation that in the limit of infinite density one recovers the Weiss molecular field. The formal parameter of expansion is 1/z where z is the number of spins in the range of the exchange potential (not restricted to nearest neighbour interactions). In the absence of long-range order, only ring diagrams in the cluster expansion contribute. These give a divergence in the specific heat at $kT_c = \Sigma_{j \neq i} v_{ij}$ where v_{ij} is the exchange potential. This is the molecular field value for the Curie point T_c. In the presence of a magnetic field the partition function is evaluated for fixed magnetic moment M in the same approximation, M being determined by minimization. This results in a susceptibility differing from the molecular field theory and hence an inconsistency in the theory. The inconsistency is traced back to the observation that the acceptance of ring diagrams is equivalent to the gaussian model of Kac and Berlin which violates the sum rule $\Sigma_{i=1}^{N} \mu_i^2 = N$. Here μ_i is the "spin" per particle and N is the total number of particles. This condition is reinstated by insuring the sum rule. The result leads to the spherical model. Thus, a consistent high density approximation to the Ising model is the spherical model. Below the Curie point or for fixed magnetic field, M is again held fixed and only the Fourier components of the spin density with nonvanishing wave vector are "sphericalized". The result leads to a physically acceptable model which becomes the molecular field theory at low temperatures or high fields and deviates in O(1/z) in general. Formally, the results are simply expressed in terms of a temperature dependent Weiss field. These results differ from the ordinary spherical model which is physically unacceptable below the Curie point. However, a molecular field modification of the spherical model due to Lax yields the same result when properly interpreted. It is shown that the above results are also valid (to the same approximation) in the quantum mechanical Heisenberg model, for temperatures above the Curie point.

539.2 : 538.2

18173 THEORY OF A HEISENBERG FERROMAGNET IN THE RANDOM PHASE APPROXIMATION. F.Englert.

Phys. Rev. Letters, Vol. 5, No. 3, 102-3 (Aug. 1, 1960).

The random phase approximation is introduced by means of approximate commutation rules and is conjectured to be valid in the high-density limit. For the case of spin $\frac{1}{2}$ the magnetization is obtained as a function of temperature T over the whole temperature range. At low temperatures there is a T^3 correction to the $T^{3/2}$ law. A similar correction was introduced by Brout and Haken [Bull. Amer. Phys. Soc. Vol. 5, 148(1960)] but an error in their analysis is mentioned. The Curie point and the susceptibility above it coincide with results obtained from the spherical model. D.M.Edwards

539.2 : 538.2

18174 SPIN WAVES IN COMPLEX EXCHANGE-COUPLED LATTICES AND NEUTRON SCATTERING. A.W.Sáenz.

J. appl. Phys., Suppl. to Vol. 31, No. 5, 108S-109S (May, 1960).

A spin-wave theory of Holstein-Primakoff type is developed for exchange-coupled lattices with an arbitrary number n of magnetic ions per primitive magnetic unit cell. This theory is used to obtain a cross-section formula for the one-magnon zero-phonon scattering of arbitrarily polarized neutrons by such lattices for the case of complete orbital quenching of the magnetic ions thereof. For $n>1$, this equation can be reduced to a simple approximate form in a limiting case, of interest for certain ferrimagnets, which involves only the scattering of "acoustic" magnons of sufficiently large wavelengths. The parallelism between this last result and the specialization of the above cross-section formula for simple ferromagnets ($n = 1$) is pointed out.

539.2 : 538.2

18175 THEORY OF MAGNETISM AND THE GROUND-STATE ENERGY OF A LINEAR CHAIN. D.I.Paul.

Phys. Rev., Vol. 118, No. 1, 92-9 (April 1, 1960).

The theory of strong magnetic effects is investigated from the point of view of orthogonal atomic functions for the case of one dimension. Thus, the exchange integral is considered positive and the interaction between the polar and the nonpolar states for all possible arrangements of electron spins is included in this formulation of the problem. The resulting secular equations are solved for both large and small interactions between states for the case of only one electron spin oriented in a direction opposite to all other electron spins, and they are solved for small interactions between states for the more general case of any number of electron spins being in a given direction. It is shown how inclusion of the polar states can yield either a ferromagnetic or an antiferromagnetic ground state depending on the difference in absolute magnitude between the exchange integral and the sum of other integrals representing electron-nuclei interactions.

539.2 : 538.2

18176 MAGNETISM AND THE GROUND-STATE ENERGY OF A LINEAR CHAIN. II. CONFIGURATION INTERACTION EFFECTS. D.I.Paul.

Phys. Rev., Vol. 120, No. 2, 463-8 (Oct. 15, 1960).

Continuation of Pt I (see preceding abstract), in which the ground-state energy of a one-dimensional chain of atoms was investigated from the point of view of orthogonal atomic functions. Thus, the exchange integral is positive and the configuration interaction between polar and nonpolar states is included. The results are extended to include the condition of a large amount of overlap among the unperturbed nonorthogonal atomic functions resulting in a strong interaction between the orthogonalized nonpolar and polar energy states for the case of two electrons having their spins oriented opposite to all other electron spins. These results indicate that for this case the energy of the unmagnetized state is lower than that obtained when all the electron spins are parallel and that the system is nonferromagnetic.

539.2 : 538.2

18177 DIRECT EXCHANGE IN FERROMAGNETS. R.Stuart and W.Marshall.

Phys. Rev., Vol. 120, No. 2, 353-7 (Oct. 15, 1960).

The direct exchange integral which occurs in the Heisenberg theory of ferromagnetism is evaluated for all internuclear spacings. It is found to be always positive, whereas Bethe originally suggested it would be positive only at large spacing and more recently it has been suggested that the integral should always be negative. However, at the observed internuclear separation the magnitude calculated is of the order of 70 times too small to explain the experimentally determined exchange constant in ferromagnet
metals, and it is therefore concluded that direct exchange is
responsible for ferromagnetism in these metals.

539.2 :

18178 ON THE THEORY OF COOPERATIVE PHENOME IN CRYSTALS. C.Domb.

Advances in Phys., Vol. 9, No. 34, 149-244 (April); No. 35, 24
(July, 1960).

An analysis is given of the major stages in the theoretic
development which now allows definite conclusions to be draw
about the behaviour of simple models of cooperative processe
This review article is divided into nearly self-contained secti
Section 2 describes the properties of regular assemblies and
duces the Ising model of a ferromagnetic crystal. Section 3 i
devoted to exact solutions for the partition function of one and
dimensional assemblies. The discussion is restricted to zer
external magnetic field in the latter case. Exact series expa
sions of the partition function in the limits of low and of high
temperature, and their use in the location of the singularities
the function for three dimensional assemblies, or when the m
tic field is non-zero, are described. Approximation methods,
have been used for detailed calculation of the properties of th
dimensional models, are critically surveyed in section 4. The
physical properties of the three-dimensional Ising model are
cribed in detail. Some technical features of the approximate
methods of solution are contained in section 5. In particular
use of configuration methods in perturbation expansions is dis
cussed in detail. Some important results are presented in ap
dices to sections 3 and 5 and reference to others is made thro
the extensive bibliography. P.J

539.2 :

18179 A CONTRIBUTION OF DISLOCATIONS TO THE I TIAL SUSCEPTIBILITY IN A SOFT MAGNETIC MATERIAL. G.Rieder.

Z. Naturforsch., Vol. 15a, No. 8, 746-8 (Aug., 1960). In Germ

Kersten's theory of initial susceptibility due to domain w
curvature in applied fields assumes a rigid adherence of the
to their traps. In practice, because of their finite thickness,
are driven gradually across obstacles and this influences the
tial susceptibility. The size of the effect is calculated approxi
mately for domain walls interacting with dislocations and the
obtained for nickel is compared with that derived from Kerste
equation. It turns out that the latter is not appreciably modifi
at room temperature. The temperature dependence is discuss
qualitatively. R.P.

539.2 :

18180 THE MAGNETO-OPTICAL KERR EFFECT IN FE MAGNETIC SUBSTANCES SITUATED IN A RADIO-FREQUENCY FIELD. G.V.Skrotskii and T.G.Izyumova.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1739-40 (Aug., 1960). In Rus

This is calculated for the case of the direction of propaga
of a linearly polarized light wave, falling normally on a ferron
netic mirror magnetized to saturation, coincident with the dire
of a constant magnetizing field. The refractive indices for cir
arly polarized light and the angle of rotation of plane polarized
light were derived and the effect of a radiofrequency field is gi
In the region of ferromagnetic resonance there should be a not
able reduction in the rotation. The theory is for the penetratio
depth of the radiofrequency waves considerably greater than th
the light waves. In metallic ferromagnetics this holds even at
maximum of ferromagnetic resonance for frequencies $\sim 10^{10}$ c
R.Be

539.2 :

18181 THEORY OF WEAK FERROMAGNETISM. E.A.Turov.

Zh. eksper. teor. Fiz., Vol. 36, No. 4, 1254-8 (April, 1959). In
Russian. English translation in: Soviet Physics—JETP (New Y
Vol. 36(9), No. 4, 890-3 (Oct., 1959).

A number of properties of weak ferromagnetics have been
gated at low temperatures using Dzyaloshinskii's theory (Abstr
6045 of 1958), which considers weak ferromagnetism to be the
quence of the magnetic symmetry of antiferromagnetic crystal
well-defined magnetic structure. The case is considered of "t
verse" and of "longitudinal" weak ferromagnetism (in the first
the spontaneous magnetic moment is perpendicular, and in the
parallel to the antiferromagnetic axis). The spin wave energy,
temperature dependence of the magnetization and its field depe
and the spin part of the heat capacity are evaluated.

539.2 : 538.2

32 THE SPECIFIC FEATURES OF THE TEMPERATURE DEPENDENCE OF THE ENERGY OF THE MAGNETIC STROPY OF CRYSTALS NEAR THE MAGNETICALLY-PIC STATE.

I.M.Puzei.
etallov i Metallovedenie, Vol. 9, No. 2, 302-3 (Feb., 1960).
sian.
eoretical. The previously established fact that in a certain
ature range the temperature dependence of the magnetic
opy constants of Fe—Ni, Fe—Co, Ni—Co and Permalloy
crystals becomes identical with that obtained for MnBi and
is discussed. It is shown that these anomalies are very likely
the fact that the temperature dependence under consideration
he case of alloys characterized by a high degree of magneto-
on, strongly affected by the sum of the elastic and magneto-
energies. M.H.Sloboda

539.2 : 538.2

83 OBLIQUE-INCIDENCE ANISOTROPY IN EVAPORATED PERMALLOY FILMS.

nith, M.S.Cohen and G.P.Weiss.
. Phys., Vol. 31, No. 10, 1755-62 (Oct., 1960).
agnetic anisotropy has been observed in evaporated Permalloy
deposited at oblique incidence of the vapour. Electron micro-
of such films reveal chains of crystallites whose long axes
iented perpendicular to the vapour beam. A "self-shadowing"
is proposed to explain chain growth, i.e. the area behind a
llite is left vacant because it is in the crystallite's shadow.
ed crystallite chains are thus caused by a purely geometric
s; their existence has also been demonstrated for Au, Pt, W,
. Oriented chains give rise to a number of macroscopic
: magnetic anisotropy, anisotropic resistance, dichroism,
isotropic resonance linewidth. Experiments involving the
ing of oblique-incidence Permalloy films from their sub-
s indicate the presence of an anisotropic strain which, in
tion with magnetostriction, gives another contribution to the
tic anisotropy; this contribution explains the observed com-
nal dependence of the magnetic anisotropy. Surface tension,
tends to contract the crystallite chains, is postulated as the
ting force of anisotropic strain; surface tension could simi-
generate the isotropic strain which is found in normal-inci-
films.

539.2 : 538.2

84 MAGNETIC VISCOSITY OF MAGNETITE.

Y.Shimizu.
magn. Geoelect., Vol. 11, No. 4, 125-38 (1960).
he magnetic viscosity of an ensemble of medium-sized
s of natural magnetites was examined at various temperatures.
found that the magnetic viscosity coefficient S, defined as
S(Q + log t) where I and I_0 are intensity of magnetization at
and t = 0, was proportional to external magnetic field, and
was a linear function of temperature, except at temperatures
to the Curie point and at −160° C, sofar as the Rayleigh region
gnetization was concerned. S appeared to tend to a finite
as the grain size tended to the order of a single domain.
n ensemble of magnetite grains, S in the expression
(Q + log t) was very small, and the limit of half-life time
changes in thermoremanent magnetization, expressed by
p(I_{tr}/2S) amounted to 10^{120} years. The half-life time for
entary rocks, in which directions of grain magnetization are
red, with reduction factor w, was about 10^{10} years for
/5. These results show that remanent magnetization of
us and sedimentary rocks may have been stable against thermal
sity for a long geological time.

539.2 : 538.2

185 FERROMAGNETIC VISCOSITY DUE TO INTERSTITIALS IN NEUTRON IRRADIATED NICKEL.

onmüller, A.Seeger and P.Schiller.
aturforsch, Vol. 15a, No. 8, 740-1 (Aug., 1960). In German.
The relaxation time for magnetic viscosity of an irradiated
men is found to depend in the same way on the temperature as
of a plastically deformed specimen, leading to a common acti-
n energy 0.81 eV; the recovery process during annealing is
similar, with activation energy 1.02 eV. E.P.Wohlfarth

539.2 : 538.2

186 THE INFLUENCE OF FINELY DISPERSED PRECIPITATES ON THE COERCIVE FORCE OF TRANSFORMER ET.

R.Wagner.

Acta metallurgica, Vol. 7, No. 7, 523-5 (July, 1959). In German.

The influence of annealing temperature and annealing time on the coercivity of hot-rolled sheet with 4.1% Si content, initially homogenized for 0.5-1 hr at 1000° C and then quenched in water at room temperature, was studied. The coercivity has a maximum for annealing temperature of 500° C. The rise in coercivity is produced by finely dispersed precipitates which were observed microscopically to be of 1-6 μ width and 0.4 μ thickness, and agrees with Néel's theory (Annales de l'Université de Grenoble, Vol. 22, 299, 1946). S.Weintroub

539.2 : 538.2

18187 ON THE DEPENDENCE OF THE EFFECT OF THERMO-MAGNETIC TREATMENT ON THE INITIAL PROPERTIES OF PERMALLOY.

M.G.Luzhinskaya, L.O.Fremderman and Ya.S.Shur.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 300-2 (Feb., 1960). In Russian.

The effect of thermomagnetic treatment on specimens of 66% Ni—34% Fe alloy, subjected to various preliminary mechanical and thermal treatment and consequently characterized by coercive forces of various magnitude, was studied. The results indicated that the higher the degree of perfection of the crystal lattice of a given alloy (as determined by its mechanical and thermal history) the greater is the effect of the thermomagnetic treatment on its magnetic properties. M.H.Sloboda

539.2 : 538.2

18188 KINETICS OF MAGNETIC ANNEALING IN COBALT-SUBSTITUTED MAGNETITE.

W.Palmer.

Phys. Rev., Vol. 120, No. 2, 342-52 (Oct. 15, 1960).

The time dependence of the magnetic annealing effect in single crystals of magnetite containing various amounts of substituted cobalt was investigated by a technique which permits observation of the effect at the annealing temperature. The annealing kinetics in a particular crystallographic direction are determined by measuring the decay of the torque in the (001) plane following a preparatory anneal in a direction of 45° removed. The directions chosen for study are the [100] and [110] directions, which are nodes of the cubic torque curve. The absence of a cubic torque in the directions of measurement allows precise observation of the annealed-induced uniaxial torque. The annealing kinetics observed in the two directions are different, and the nature of the torque decay in both directions depends upon the cobalt concentration of the sample. The torque decay in the [100] direction is attributed to the redistribution of single cobalt ions and certain pairs of adjacent cobalt ions over the octahedral cation sites, whereas the decay in the [110] direction is attributed to the redistribution of cobalt ion pairs only. The results of a theoretical analysis of the annealing kinetics that would result from such ionic redistribution are in good agreement with the experimental observations. Comparison of the annealing behaviour of samples in different states of oxidation indicates that ionic redistribution occurs by a vacancy diffusion mechanism, and the activation energy observed for this process is 1.05 ± 0.03 eV. In addition to the measurements performed at the annealing temperature, the torque in the [110] direction was determined as a function of temperature in a sample which had been quenched at the end of its preparatory anneal. These two measurements are used to show that there exists a repulsive interaction energy of 0.093 ± 0.04 eV between two adjacent cobalt ions.

539.2 : 538.2

18189 EFFECT OF NEUTRON BOMBARDMENT ON THE MAGNETIC PROPERTIES OF VERY HIGH PERMEABILITY IRON.

G.Biorci, A.Ferro and G.Montalenti.

J. appl. Phys., Vol. 31, No. 11, 2046-7 (Nov., 1960).

Rings of iron with permeability of about 150 000, after neutron bombardment (1×10^{18} n.v.t.), show lower permeability and higher coercive force. This effect can be interpreted as due to large defects giving long range internal stresses, or as due to anisotropic defects interacting with the magnetization vector at each point of the specimen.

539.2 : 538.2

18190 DOMAINS IN THIN MAGNETIC FILMS OBSERVED BY ELECTRON MICROSCOPY.

H.W.Fuller and M.E.Hale.

J. appl. Phys., Vol. 31, No. 10, 1699-1705 (Oct., 1960).

A new method for observing full domains in thin magnetic films by electron microscopy is described. Observations are made with standard transmission instruments utilizing an off-centered objective aperture diaphragm as a knife edge. The method has the high-resolution advantage that the microscope is focused on the specimen during domain observations. Limitations of the method and comparisons with the previously reported defocusing technique are presented. Applications to the interpretation of complex domain patterns and cross-tie walls are demonstrated. The observations were made with electrostatic-focusing microscopes, the AEG-Zeiss and Trüb-Täuber instruments, which allow the use of full objective power without influencing the magnetization distribution of low coercive force films. A second method using a knife edge is proposed that would potentially permit a simple measurement of the detailed magnetization distribution of a domain wall in a thin film.

539.2 : 538.2

18191 CROSS-TIE WALLS IN THIN PERMALLOY FILMS.

M.Prutton.

Phil. Mag. (Eighth Ser.), Vol. 5, 625-33 (June, 1960).

A solution of the non-linear differential equations of a domain boundary is reported for the case of a thin film in which the demagnetizing energy associated with the magnetization at right angles to the plane of the film is included. The solution leads to a proposal for the internal structure of the cross-tie wall which has been observed in thin films of Permalloy. The effects of the magnetic poles in this model of a cross-tie wall are discussed and compared with observations. The energy density of the wall is suggested to be about 10 erg/cm^2 and the correlation between cross-tie spacing and length is derived.

539.2 : 538.2

18192 SMALL-ANGLE GRAIN BOUNDARIES AS OBSTACLES TO THE MOVEMENT OF BLOCH WALLS ON SILICON—IRON.

W.Stephan.

Z. angew. Phys., Vol. 12, No. 9, 398-400 (Sept., 1960). In German.

It is shown by powder pattern observations that the movement of walls of the small domains on surfaces slightly inclined to (100) planes is impeded by small-angle grain boundaries.

E.P.Wohlfarth

539.2 : 538.2

18193 ON THE BEHAVIOUR OF MAGNETIC POWDER IN A ROTATING MAGNETIC FIELD.

E.Laurila.

Ann. Acad. Sci. Fennicae A VI, No. 34, 13 pp (1959).

The behaviour of dry magnetic powder in the rotating magnetic field on the surface of the drum in a dry magnetic separator has been studied theoretically. The formation of elongated clusters of considerable strength and its dependence on characteristic parameters such as permeability of the material, field strength and field frequency has been analysed as well as the breaking of these clusters. It has been shown, that in high frequency fields the clusters are making jumps above the surface so that the powder forms a cloud moving above the surface of drum rather than rolling on the surface itself.

539.2 : 538.2

18194 FREE AND FORCED OSCILLATIONS OF THE MAGNETIZATION IN THIN PERMALLOY FILMS.

P.Wolf.

Z. Phys., Vol. 160, No. 3, 310-19 (1960). In German.

Free oscillations ranging from 500 to 1100 Mc/s were excited in these films by a pulse field with a risetime less than 0.35 nsec, and observed with a sampling oscilloscope. The eigenfrequencies and the damping constants of these free oscillations are compared with the resonance frequencies and the damping constants of forced oscillations obtained in ferromagnetic resonance experiments. Perpendicular and parallel orientation of the magnetization with respect to the easy direction of the induced uniaxial anisotropy of the film are considered. The results show reasonable agreement with theoretical values gained from the Landau—Lifshits equation.

539.2 : 538.2

18195 A METHOD OF MEASURING THE MAGNETIC PROPERTIES OF A THIN SURFACE LAYER OF A FERROMAGNETIC.

G.S.Krinchik.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1945-8 (Aug., 1960). In Russian.

By an experimental method of which details have been given previously, the magnetic properties of surface films of a ferromagnetic, of thickness less than 1μ have been measured. The equatorial Kerr effect is used, since it has some advantages over the polar Kerr effect, for the purpose in view. Hysteresis loops are exhibited, obtained with mechanically polished nickel and Permalloy. (See Abstract 6171 of 1960).

N.Davy

539.2 :

18196 THEORY OF MAGNETOSTRICTIVE OSCILLATIO IN THE CASE OF LARGE EXCITATION INDUCTIC

L.N.Sÿrkin.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1900-8 (Aug., 1960). In Rus

By calculating the higher terms in the magneto-elastic po
of the thermodynamic potential of a ferromagnetic, formulae a
obtained for the component tensors of the dynamic magnetostr
constant of a magneto-polarized medium, and for the magneto-
mechanical non-linearity. An analysis of these formulae is gi
and experimental methods of testing the theory are suggested.
more accurate expression for the magnetostrictive constant in
case of large excitation inductions is obtained.

N

539.2 : 538.2 : 621.374.32 : 621

18197 EFFECT OF GEOMETRY ON THICK FILM TOROI

J.C.Sagnis, Jr, M.Teig and R.L.Ward.

J. appl. Phys., Suppl. to Vol. 31, No. 5, 190S-191S (May, 1960).

In the study of thick-film (1-20 μ) magnetic circuits, it ha
been found that thick film cores of certain sizes could not be
completely switched if a concentrated drive winding was used.
addition, the induced voltages differed in waveshape as a functi
the location of the sense windings with respect to the concentr
drive winding. Both phenomena were obviously detrimental to
"normal" operation of the device as a magnetic storage or log
element. Studies of these phenomena were conducted using pla
thick film toroids, photo-etched from $\frac{1}{4}$-mil and $\frac{1}{2}$-mil thick
Square Loop Hy-Mu 80. From the results of these studies,
qualitative explanation of the aforementioned phenomena is offe
in the form of a three-part flux-pattern model.

539.2 : 5

18198 VALUE OF g' FOR SUPERMALLOY.

G.G.Scott.

Phys. Rev., Vol. 120, No. 2, 331 (Oct. 15, 1960).

The gyromagnetic ratio of supermalloy was determined by measurements of the Einstein—deHaas effect, using the experimental arrangement of Abstr. 11924 of 1960. The value of 1.905 ± 0.002 obtained for g' is equivalent to a spectroscopic splitting factor g of 2.105. This is good agreement with values obtained by ferromagnetic resonance experiments.

539.2 :

18199 LONG-TERM MAGNETIC STABILITY OF ALNICO BARIUM FERRITE MAGNETS.

K.J.Kronenberg and M.A.Bohlmann.

J. appl. Phys., Suppl. to Vol. 31, No. 5, 82S-84S (May, 1960).

Alnico and barium ferrite materials do not age at room te
ture. The decreases in remanence, occuring with time, are ad
ments by the magnet to its environment. Remanence adjustme
proceeds with the logarithm of time and amounts to 2% or less
year after magnetization. Remanences in magnets with $H_{ci} > 2$
show no changes. Also, the smaller the irreversible susceptib
at the operating point, the more stable is remanence. Remanenc
be stabilized completely by preadjustment. Alnico V magnets
more stable than similar Alnico III magnets, even when the Al
magnets operate at a higher susceptibility. Néel's theory sugg
that the oriented material is more stable than the isotropic ma
because larger volumes are involved in each magnetization re
To explain relatively large domain-line regions of reversal, or
to assume that magnetic regions cooperate during the magnetiz
reversal.

539.2 :

18200 INTERACTION BETWEEN HIGH-POWER MICROW LOSSES AND MAGNETIC FLUX REVERSAL.

E.M.Gyorgy and F.B.Hagedorn.

J. appl. Phys., Vol. 31, No. 10, 1775-8 (Oct., 1960).

The off-resonance microwave absorption (subsidiary absor
which frequently occurs at high-microwave power and which m
exist even in the absence of an external d.c. magnetic field has
used to observe the interaction between the magnetic flux rever
and the microwave loss processes in polycrystalline ferrite. T
experiments have shown that the spin waves associated with hi
power, off-resonance microwave absorption have a negligible e
on the flux reversal process. However, the flux reversal proc
has a marked effect on the high-power microwave loss. Durin
flux reversal process, this high-power, off-resonance microwa
absorption was found in some cases to be negligible.

539.2 : 538.2

01 A METHOD OF MEASURING THE COMPLEX MAGNETIC PERMEABILITY OF A FERRITE MATERIAL. R.Kalnin'.
PSR Zinat. Akad. Vestis, No. 1(150), 77-9 (1960). In Russian.
he paper is largely concerned with the measurement of Q, the
factor of a ferrite, in the form of a toroid: Q is equal to
(+ $1/Q_0$), not simply μ'/μ'' as is often assumed. Q_0 is the
factor of the "coreless" toroidal coil wound round the
nen By the aid of theoretical graphs it is shown that when
the Q-meter method it is necessary that Q_0 should be not less
n, in order to get results accurate to 5%. Experiment
rts the theory. The effective inductance $L = L_0\mu'$ of the
nen is also measured. Knowing Q, Q_0 and L, μ' and μ'' can be
ated. N.Davy

539.2 : 538.2

02 THEORY OF WEAK FERROMAGNETISM IN RARE EARTH ORTHOFERRITES.
urov and V.E.Naish.
letallov i Metallovedenie, Vol. 9, No. 1, 10-18 (Jan., 1960).
sian.
he properties are studied of orthorhombic magnetic crystals
the structure of rare earth orthoferrites. Using a pheno-
ogical Hamiltonian derived from symmetry considerations,
ions are found under which weak ferromagnetic states exist
se crystals. The magnetization curve along three principal
l axes, the spin-wave spectrum and the temperature depend-
f spontaneous magnetization in the weak ferromagnetic state
nsidered. It is predicted that the spontaneous magnetization
l increase with temperature.

539.2 : 538.2

03 DEPENDENCE OF THE MAGNETIC SUSCEPTIBILITY OF Ba FERRITE ON TEMPERATURE.
orovik and Yu.A.Mamalui.
Metallov i Metallovedenie, Vol. 9, No. 1, 36-40 (Jan., 1960).
ssian.
amples of $BaO \cdot 6Fe_2O_3$ (prepared from powders of $BaCO_3$ and
by sintering at 1200° C) were investigated in the temperature
from room temperature to 550° C, using a ballistic method.
esults show good agreement with Neel's theory of paramag-
susceptibility up to 469° C (Curie point 450° C). The initial
ptibility is calculated to be 0.012, in disagreement with the
red value of 0.04.

539.2 : 538.2

204 MANGANESE—ZINC FERRITES WITH SPONTANEOUS ISOPERM-LOOP. M.Kornetzki, E.Moser and E.Röss.
wissenschaften, Vol. 47, No. 12, 274 (1960). In German.
The relative remanence of an isotropic polycrystalline ferrite
23.5% MnO, 24% ZnO is as low as 0.15 and the initial perme-
y 4.4 × 10^3; these results are ascribed to a complicated domain
ture containing a large number of walls. E.P.Wohlfarth

539.2 : 538.2

205 ANISOTROPIC SUPEREXCHANGE INTERACTION AND WEAK FERROMAGNETISM. T.Moriya.
Rev., Vol. 120, No. 1, 91-8 (Oct. 1, 1960).
theory of anisotropic superexchange interaction is developed
tending the Anderson theory of superexchange to include
-orbit coupling. The antisymmetric spin coupling suggested by
oshinski from purely symmetry grounds and the symmetric
odipolar interaction are derived. Their orders of magnitudes
stimated to be $(\Delta g/g)$ and $(\Delta g/g)^2$ times the isotropic super-
nge energy, respectively. Higher order spin couplings are
discussed. As an example of antisymmetric spin coupling the
of $CuCl_2.2H_2O$ is illustrated. In $CuCl_2.2H_2O$, a spin arrange-
which is different from one accepted so far is proposed. This
ymmetric interaction is shown to be responsible for weak
magnetism in α-Fe_2O_3, $MnCO_3$, and CrF_3. The paramagnetic
ptibility perpendicular to the trigonal axis is expected to
ase very sharply near the Néel temperature as the temperature
vered, as was actually observed in CrF_3.

539.2 : 538.2

3206 MODEL OF EXCHANGE-INVERSION MAGNETIZATION. C.Kittel.
. Rev., Vol. 120, No. 2, 335-42 (Oct. 15, 1960).
A thermodynamic theory is given of a class of magnetic
tals which transform from ferromagnetic to antiferromagnetic
s as the temperature is varied. Applications are suggested to
$Mn_{2-x}Cr_xSb$ and to crystals having the nickel arsenide type structure. It is shown that the exchange magnetoelastic energy is often important in such transformations and leads to an additional interaction energy of the form $(\vec{S}_A \cdot \vec{S}_B)^2$ in the effective spin Hamiltonian. It is suggested that one of the exchange constants goes linearly through zero near a critical value of some lattice coordinate characterizing the transition. There are important differences in the behaviour of compact and noncompact antiferromagnetic lattices, under the assumption of nearest-neighbour interactions between sublattices. A triangular array is treated, such as might arise in crystal structures of the NiAs type.

539.2 : 538.2

18207 SUPEREXCHANGE INTERACTION OF MnO. J.Kondo.
Progr. theor. Phys., Vol. 22, No. 1, 41-61 (July, 1959).

The magnitude of the superexchange interaction is calculated according to the methods proposed previously (Abstr. 2387 of 1958). Various mechanisms of superexchange interaction are taken into consideration. Overlaps between neighbouring ions are assumed to be small and the energy of the crystal is developed in powers of S, the overlap integral between manganese and oxygen ions. The superexchange interaction of all mechanisms appears from S^4 terms and it is concluded from calculation that the Slater mechanism may play a dominant role in MnO. The numerical value of the magnitude of interaction agrees with experiment in the order of magnitude. Several discussions about superexchange interactions of other substances, particularly of MnF_3 and $LaMnO_3$, are given.

539.2 : 538.2

18208 NEW METHOD FOR TREATING THE ANTIFERROMAGNETIC GROUND STATE. H.L.Davis.
Phys. Rev., Vol. 120, No. 3, 789-801 (Nov. 1, 1960).

A perturbation expansion for the ground-state energy of an antiferromagnetic spin system is obtained in terms of a linked-spin-cluster expansion similar to Goldstone's linked Feymann-diagram expansion for the interacting Fermion system. From the energy perturbation series, perturbation series for the long- and short-range order may be obtained. Using these perturbation series, the ground-state properties are calculated through seventh order and compared with the results obtained by other investigators. In all cases, the values obtained here for the ground-state energy are lower than those which have been obtained by purely variational means. The results for the long-range order are radically different from the variational results but agree qualitatively with those obtained by spin-wave theory; however, the method is free of the usual objections which are voiced to spin-wave treatments of antiferromagnetism. The present work is incomplete in that limits on the error introduced by using only a finite number of terms of the perturbation series to calculate the physical properties are not obtained. But the author feels that the merit of the present work is in the method rather than the results since it provides a consistent framework both to settle the convergence question and to treat the antiferromagnetic spin system at finite temperatures.

539.2 : 538.2

18209 ALPHA-TRANSFORMATION MECHANISM OF THE ANTIFERROMAGNETIC IRON SULFIDE. M.Murakami.
Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 2, 53-61 (Aug., 1959).

The anomalous behaviour of susceptibility in the α-transformation of FeS, especially that on cooling process, has been observed. In order to elucidate the nature of the α-transformation, a dilatometric measurement has been independently made. A mechanism has been proposed for the α-transformation, and the anomalous behaviour observed has been explained qualitatively by the proposed mechanism — the simultaneous changes of the antiferromagnetic exchange energy constant and the sign of the anisotropy energy constant.

Magnetic Resonances

539.2 : 538.27

18210 INTERACTION OF PHONONS AND SPIN WAVES IN YTTRIUM IRON GARNET. E.H.Turner.
Phys. Rev. Letters, Vol. 5, No. 3, 100-1 (Aug. 1, 1960).

Reports measurements of the variation of spin-wave linebreadth as a function of $(H_m - H)^{1/2}$, (where H is the applied d.c. field, and H_m the limiting value of H for $\pi/2$-directed spin-waves as k approaches zero), and of the critical strength of r.f. magnetic field for unstable growth in amplitude of spin-waves as a function of applied magnetic field. Single crystal spheres of YFe garnet, 0.019 in. in diameter, were used at 300° K with a pumping frequency of 34.627 kMc/s. On each curve two anomalous peaks were observed. These are attributed to interaction of the spin-waves with phonons. The mechanism is discussed. S.A.Ahern

539.2 : 538.27

18211 FERRIMAGNETIC RESONANCE IN RARE-EARTH DOPED YTTRIUM IRON GARNET. I. FIELD FOR RESONANCE. J.F.Dillon,Jr and J.W.Nielsen.

Phys. Rev., Vol. 120, No. 1, 105-13 (Oct. 1, 1960).

Resonance experiments were performed on YFe garnet crystals doped with each of the rare earth ions except Lu, Gd, and Pm. Except for Ce these are thought to replace Y as trivalent ions. This paper presents measurements of the field for resonance in the (110) plane at 1.5°K for each of these samples. In several cases there are also data up to about 25°K. Except for Ce, Eu, and Tm the curve H_{res} in (110) at 1.5°K shows characteristic structure. For Pr, Ho, and Tb this structure is dominated by very narrow peaks in H_{res}. For Nd, Sm, Dy, and Er it is relatively broad in angle. For Yb most of the structure is relatively broad in angle, but there is a very sharp but small spike in H_{res}. Only in the case of Tb and Yb do sharp spikes appear at other than symmetry directions. In some cases the height of the peaks falls off rapidly with increasing temperature starting at the lowest temperatures, but in other cases it does not change at first, then falls off.

539.2 : 538.27

18212 SPIN RESONANCE OF THE CONDUCTION ELECTRONS IN FERROMAGNETIC METALS.

Yu.A.Izyumov and G.V.Skrotskii.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1766-72 (Aug., 1960). In Russian.

The assumption is made that the effective mass of a conduction electron depends on the orientation of its spin with respect to the direction of the spontaneous magnetic moment. This assumption leads to the prediction of spin resonance absorption line shapes which are neither Lorentzian nor Gaussian and which show specific properties of the Fermi system. J.G.Powles

539.2 : 538.27

18213 THE INFLUENCE OF THE INTERNAL ELECTRIC FIELD IN NON-CONDUCTING PARAMAGNETIC SINGLE CRYSTALS ON THE TWO-PARTICLE SPIN—SPIN INTERACTION.

N.G.Koloskova and U.Kh.Kopvillem.

Fiz. tverdogo Tela, Vol. 2, No. 7, 1368-78 (July, 1960). In Russian.

The second and fourth moments of the distribution curve of the non-diagonal matrix elements of the spin—spin interaction operator are calculated, taking account of the spin coefficients of the dipole—dipole Hamiltonian and the anisotropic exchange interactions between ions having an anisotropic g-factor and effective spin $\frac{1}{2}$. The results obtained are used to study paramagnetic resonance and free magnetic induction line shapes, and the order of the relation time is calculated. Numerical calculations are made for rare earth ethyl sulphates and double nitrates. For Nd ethyl sulphate the experimental values of $< (\Delta\nu)^2 >$ and $< (\Delta\nu)^4 >^{1/4} < (\Delta\nu)^2 >^{-1/2}$ agree with the assumptions made, but for Ce ethyl sulphate and Sm magnesium nitrate the disagreements are ascribed to the influence of a second doublet at the temperature of the measurements, and the variation of the field from ion to ion, respectively. R.Berman

539.2 : 538.27

18214 FORBIDDEN TRANSITIONS IN PARAMAGNETIC RESONANCE. L.L.Buishvili and G.R.Khutsishvili.

Fiz. tverdogo Tela, Vol. 2, No. 8, 1685-8 (Aug., 1960). In Russian.

A calculation is presented of the energy levels and transition probabilities of so-called forbidden transitions (i.e. $\Delta m \neq 0$) in electron paramagnetic resonance where there is an electron—nuclear interaction, but only for the case of axial crystalline field and for the external magnetic field in this direction. This should have application to paramagnetic salts and semiconductors containing donor or acceptor impurity atoms. It is claimed that a study of forbidden transitions allows a more accurate determination of nuclear quadrupole interaction and nuclear g-factor. J.G.Powles

539.2 : 538.27

18215 RELAXATION IN RUBY.

R.A.Armstrong and A.Szabo.

Canad. J. Phys., Vol. 38, No. 10, 1304-17 (Oct., 1960).

The relaxation of the (1 ↔ 2) and (2 ↔ 3) transitions in chrome-doped Al_2O_3 (0.015%) has been studied at S-band, using a pulsed microwave method over a range of crystal orientations in the
magnetic field at temperatures of 77°K to 50°K, and at 4.2°K ar
1.6°K. A T^{-7} variation of the relaxation time with temperature
found in the liquid nitrogen range. The relaxation time in this t
perature range was found to be independent of crystal orientatic
and for the (1 ↔ 2) transition was 50 microseconds at 77°K. At
liquid helium temperatures, harmonic cross-relaxation was pre
over most of the range of the crystal orientation studied and wa
observed at harmonic-to-signal frequency ratios of 2 : 1, 3 : 2,
1 : 2. The harmonic cross-relaxation times were typically 10 t
100 times shorter than the lattice relaxation times, and were indep
dent of temperature. At non-harmonic points at 4.2° K, the spin—la
relaxation could be described by one time constant, a value of 3
milliseconds being typical. At harmonic points anomalously lon
relaxation times as high as 12 seconds were observed.

539.2 : 5

18216 ELECTRON SPIN RESONANCE OF TRIVALENT GADOLINIUM IN CALCIUM FLUORIDE. K.Hōrai.

Mem. Fac. Sci. Kyusyu Univ. B., Vol. 3, No. 1, 31-9 (March, 19

The electron spin resonance of trivalent gadolinium in calc
fluoride has been investigated at wavelengths of 3.13 and 0.86 c
room temperature. Seven fine structure lines due to Gd^{3+} have
observed. Having used the theory of energy levels of a $^8S_{7/2}$ state io
a cubic crystalline field together with an external magnetic field,
detailed analysis is carried out with the results of g = 1.992 ± 0
and cubic field splitting parameter $|a| = 0.0185 \pm 0.002$ cm^{-1}.
is found that Gd^{3+} is substituted for Ca^{2+} without association wi
vacancies or interstitial ions.

539.2 : 53

18217 HYPERFINE STRUCTURE OF THE F CENTER IN L W.C.Holton, H.Blum and C.P.Slichter.

Phys. Rev. Letters, Vol. 5, No. 5, 197-200 (Sept. 1, 1960).

Paramagnetic resonance spectra of LiF containing F- and M
centres were measured and 35 lines observed. Data from electr
nuclear double resonance were also obtained. The electron reso
ance is entirely due to F-centres and the line shape is accounted
by means of the double resonance (ENDOR) lines. It is conclude
that the previous suggestions of an M-centre resonance are not
substantiated. G.F.J.Garl

539.2 : 53

18218 PRESSURE DEPENDENCE OF CUBIC CRYSTALLIN FIELD SPLITTINGS OF S-STATE IONS. W.M.Walsh

Phys. Rev. Letters, Vol. 4, No. 10, 507-9 (May 15, 1960).

The electron spin resonance spectra of Mn^{2+} and Fe^{3+} ions
present as impurities in an MgO crystal were observed as a
function of pressure up to 10 000 kg cm^{-2}. Using an ionic model
it was deduced that the cubic field splittings vary approximately
the fourth power of the cubic lattice potential, in disagreement w
the theory of Watanabe (Abstr. 11944 of 1960). E.F.W.Seyn

539.2 : 53

18219 THE PARAMAGNETIC RESONANCE OF FOREIGN ATOMS IN CRYSTALS OF NaCl TYPE. A.B.Roitsi

Fiz. tverdogo Tela, Vol. 2, No. 8, 1689-1700 (Aug., 1960).
In Russian.

A spin resonance spectrum is calculated both for the freque
cies and relative intensities for atomic silver in potassium chlo
This is done both for double and zero field resonance. The spin
Hamiltonian is obtained by modifying the valence electron wave-
functions of atomic silver to allow for the effect of nearest neig
bour ions by a variational method. J.G.Po

539.2 : 53

18220 PARAMAGNETIC RESONANCE SPECTRUM OF Mn IN $ZnSiF_6{:}6H_2O$, $\Delta m = \pm 1$ TRANSITION.

E.Friedman and W.Low.

Phys. Rev., Vol. 120, No. 2, 408-10 (Oct. 15, 1960).

In the spectrum of Mn^{2+} in $ZnSiF_6{:}6H_2O$ a number of weake
lines are observed at intermediate angles of the magnetic field H
with respect to the crystal axis, in addition to the 30 allowed
transitions $\Delta M = \pm 1$, $\Delta m = 0$. These lines were measured and
assigned to $\Delta M = \pm 1$, $\Delta m \pm 1$ transitions. The relatively strong
intensity is explained and the intensity of the lines is shown to b
proportional to $(D/A)^2 \cos^2\theta \sin^2\theta$. These forbidden transitions c
be utilized for dynamic polarization of manganese nuclei.

539.2 : 538.27

21 ELECTRON SPIN RESONANCE OF SOME γ-IRRADIATED POLYMERS. K.Hukuda.

Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 41-51 (March, 1960).

e electron spin resonances of free radicals produced in the diated long chain polymers such as polyvinyl chloride, mer of vinylidene chloride and vinyl chloride, polytetra- thylene and polymethyl methacrylate have been observed at 3 cm wavelength and partially at 8mm wavelength. The f production and extinction of radicals in the polymers are sed and the hyperfine structure of the spectrum of polymethyl rylate is shown not to support the model of bi-radical for the tic centre.

539.2 : 538.27

22 INVERSION BY FAST PASSAGE IN A MULTILEVEL SPIN SYSTEM.

gner, J.G.Castle, Jr and P.F.Chester.

. Phys., Vol. 31, No. 8, 1498 (Aug., 1960).

three-level spin system is discussed in which it is possible uce an excess population in the upper level either (a) by sive fast passage inversions of the lower pair and upper states, or (b) by simultaneous fast passage when the two ions are coincident. It is shown that the latter method would ected to give a greater excess population, and this conclusion tantiated by experiments on crystals of ruby containing Cr^{3+}.

J.M.Baker

539.2 : 538.27

23 CROSS RELAXATION IN DILUTE PARAMAGNETIC SYSTEMS. A.Kiel.

Rev., Vol. 120, No. 1, 137-40 (Oct. 1, 1960).

e theory of cross relaxation developed by Bloembergen, , Pershan, and Artman (Abstr. 8354 of 1959) is applied to e of highly diluted paramagnetic salts. It is found that the moment of cross relaxation between two diluted paramag- pecies may be far greater than the sum of the second mom- individual lines which would be obtained from ordinary line- measurements. The dominance of cross relaxation can thus lained in cases where the separation between the interacting nces is up to 20 times the sum of the diluted linewidths.

539.2 : 538.27

224 OBSERVATIONS ON NUCLEAR MAGNETIC RESONANCE: VARIATION OF SPIN RELAXATION WITH CONCENTRATION OF PARAMAGNETIC ION AND SITY OF THE MEDIUM. V.Nagarajan.

. industr. Res., Vol. 18B, No. 2, 84-5 (Feb., 1959).

539.2 : 538.27

225 NUCLEAR MAGNETIC RESONANCE IN DILUTE COPPER ALLOYS AT LOW TEMPERATURES. I. EXPERIMENTAL CTS. T.Sugawara.

ys. Soc. Japan, Vol. 14, No. 5, 643-52 (May, 1959).

The nuclear magnetic resonance of Cu^{63} in dilute copper alloys een studied in order to make clear the origin of their anomalous etic, electric and thermal behaviours observed at low tempera- . The specimens were the dilute solid solutions of Ti, Cr, Mn, o, Ni, Zn and Sn in Cu. From the temperature dependence of bserved line width, it was concluded that Ti, Ni, and Zn behave n-magnetic ions while the others do as paramagnetic ions. Cu alloy showed temperature dependent paramagnetism in spite temperature independent paramagnetism in the metal. The e contribution to the widths in Cu–Cr, Cu–Mn, Cu–Fe and o in weak field showed a Curie–Weiss behaviour. The Weiss eratures obtained indicated increasing ferromagnetic inter- n with increasing solute concentration. The width in Cu–Mn roportional to the magnetic field except at very low tempera- , while those in Cu–Cr and Cu–Fe showed anomalous field dence at temperatures below 20°K. The Knight shift in these magnetic alloys was larger than that in pure Cu, but the devi- was very small at high temperatures. At very low tempera- the spin-lattice relaxation times in Cu–Cr, Cu–Mn and Fe became shorter than those in pure Cu and in non-magnetic s such as Cu–Zn.

539.2 : 538.27

8226 ON THE F^{19} N.M.R. SHIFT IN CoF_2.
S.Tosima and T.Nakamura.

. Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 25-30 (March, 1960).

Based on a theory of CoF_2 proposed by Nakamura and Taketa, the F^{19} shift in paramagnetic CoF_2 is discussed. The observed shift can be explained if the F^{19}-Co^{++} h.f.s. constant is taken to be about twice as large as that of Tinkham. The g-tensor of the lowest Kramers doublet of the Co^{++} ion is also discussed.

539.2 : 538.27

18227 INTERACTIONS OF p_σ AND p_π ORBITALS IN TRANSITION ELEMENT FLUORIDES.

R.G.Shulman and K.Knox.

Phys. Rev. Letters, Vol. 4, No. 12, 603-5 (June 15, 1960).

Nuclear magnetic resonance of fluorine was studied in single crystals of $KNiF_3$ and K_2NaCrF_6. The resonances are displaced from their normal field position because of dipole fields and hyperfine interactions arising from the unpaired electrons. The contribution of the hyperfine interactions to the observed shifts is shown to be of major importance for the crystals studied. The resonance shifts can, in fact, be interpreted directly in terms of the fraction of unpaired spins in the fluoride ion's 2s, $2p\sigma$ and $2p_\pi$ orbitals. A relatively large amount of both p_σ and p_π interactions with the d-electrons is present.

P.M.Parker

539.2 : 538.27

18228 NUCLEAR MAGNETIC RESONANCE IN SCANDIUM AND LANTHANUM METAL.

W.E.Blumberg, J.Eisinger, V.Jaccarino and B.T.Matthias.

Phys. Rev. Letters, Vol. 5, No. 2, 52-3 (July 15, 1960).

The Knight shift, k, is 0.64% at 300°K for La and ~0.25% for Sc at the same temperature. In both cases k at 1.8°K is 15% greater than k at 300°K. The line shapes are symmetrical and gaussian and have widths of 16 Oe (Sc) and 13 Oe (La). The product TT_1 = 0.2 sec°K for La and 0.6 sec°K for Sc. The dependence of k on the number of d electrons is discussed.

D.J.Oliver

539.2 : 538.27

18229 NUCLEAR MAGNETIC RESONANCE IN α AND β MANGANESE. V.Jaccarino, M.Peter and J.H.Wernick.

Phys. Rev. Letters, Vol. 5, No. 2, 53-5 (July 15, 1960).

In α-manganese a broad asymmetric line (δH = 250 Oe) was observed at 295°K, the centre of gravity of which corresponded to a negative Knight shift. No resonance was observed below the antiferromagnetic transition point at 95°K. In β-manganese the Knight shift k was ~ –0.12% and roughly temperature independent. The line-width increases from ~12 Oe at 300°K to ~48 Oe at 4°K, probably because of the appearance of short-range magnetic ordering.

D.J.Oliver

539.2 : 538.27 : 530.16

IRREVERSIBILITY IN INTERACTING SPIN SYSTEMS. APPLICATION TO CROSS-SECTION IN LiF. See Abstr.16639

539.2 : 538.27

18230 PROTON MAGNETIC RESONANCE STUDIES OF NONSTOICHIOMETRIC TITANIUM HYDRIDE.

B.Stalinski, C.K.Coogan and H.S.Gutowsky.

J. chem. Phys., Vol. 33, No. 3, 933-4 (Sept., 1960).

Diffusional narrowing of the proton resonances for the compositions $TiH_{1.61}$ to $TiH_{1.97}$ showed that hydrogen diffusion takes place by a vacancy mechanism at a rate linearly dependent on the concentration of vacancies. The activation energy for diffusion increases from 9.4 kcal/mole for $TiH_{1.607}$ to 10.2 kcal/mole for $TiH_{1.923}$. The resonances showed negative Knight shifts between –0.01 and –0.032%, the values being correlated with the bulk susceptibilities.

E.F.W.Seymour

539.2 : 538.27

18231 STRUCTURAL INVESTIGATIONS OF SHORT CHAIN MONOCARBOXYLIC ACIDS IN THE SOLID STATES BY PROTON MAGNETIC RESONANCE. I. ACETIC AND PROPIONIC ACIDS. M.Yagi.

Sci. Rep. Tohoku Univ. First Ser., Vol. 43, No. 1, 18-26 (June, 1959).

The proton magnetic resonance in the solid state of simple chain monocarboxylic acids, acetic acid (CH_3COOH) and propionic acid (C_2H_5COOH), has been measured in the wide temperature range from the temperature of liquid nitrogen to the melting points of the acids. Acetic acid exhibits a narrow absorption line due to the free rotation of the methyl group at these temperatures, while some of the methyl groups of propionic acid seem not to be in a freely rotational state at the liquid nitrogen temperature. Appearance of a small hump and growing of the liquid-like line in each central part of these lines were observed at temperatures of about

-50°C and -95°C below the melting points of acetic and propionic acids, respectively. The line shapes in which an extreme narrow line appears are similar to a sort of superposed line due to an inhomogeneity in the samples. This fact may be caused by some sorts of imperfections.

539.2 : 538.27

18232 TEMPERATURE DEPENDENCE OF THE PURE NUCLEAR QUADRUPOLE RESONANCE FREQUENCY IN $KClO_3$.

J.Vanier.

Canad. J. Phys., Vol. 38, No. 11, 1397-1405 (Nov., 1960).

The resonant frequency of the Cl^{35} nuclear quadrupole in $KClO_3$ was measured as a function of temperature in the range 15° to 77° K; previous work between 77° K and room temperature was confirmed. Comparison is made with Bayer's theory based on lattice vibrations and agreement is excellent. The ratio of the quadrupole coupling constant eQq_{zz} of the two isotopes (Cl^{35} and Cl^{37}) was measured at room and liquid air temperatures; significant changes were observed in the measurements. The possibility of using this temperature dependence as the basis of a sensitive thermometer was studied; the accuracy of such a thermometer would be ±0.005° K at 60° K and ±0.05° K at 20° K.

539.2 : 538.27

18233 SELECTIVE SPIN EXCITATION AND RELAXATION IN NUCLEAR QUADRUPOLE RESONANCE.

M.J.Weber and E.L.Hahn.

Phys. Rev., Vol. 120, No. 2, 365-75 (Oct. 15, 1960).

Nuclear relaxation in a quadrupolar spin system was investigated by selectively exciting nuclei into particular magnetic levels and observing the transient recovery of the spin system toward an equilibrium population distribution. Selective excitation is achieved by correlating the frequency and precessional behaviour of nuclei in certain states with applied elliptically and linearly polarized, pulsed radio-frequency fields. A quantum-mechanical analysis is presented to describe the excitation of a quadrupolar spin system produced by a pulsed, elliptically polarized r.f. field. Using selective excitation techniques, several new modes of longitudinal relaxation are observed. Experiments using the chlorine quadrupole resonance in a single crystal of $KClO_3$ demonstrate how these new relaxation modes are used (a) to study dynamic spin—spin interactions and cross relaxation between overlapping resonance lines, and (b) to determine the individual $\Delta m = \pm 1$ and ± 2 quadrupolar spin—lattice relaxation transition probabilities. A method is introduced by which the magnetic dipole—dipole contribution to the resonance linewidth can be determined independently of static quadrupole broadening, by observing the decay of the beat modulation of certain free-induction signals caused by precession in a small magnetic field. The measured magnetic linewidth of Cl^{35} in $KClO_3$ is in good agreement with the value obtained from a second-moment calculation.

539.2 : 538.27

18234 STUDY OF REORIENTATIONAL MOTION IN SOLID STATE OF 1,2,3-TRICHLOROBENZENE AND HEXACHLOROBENZENE BY PURE QUADRUPOLE RESONANCE.

I.Tatsuzaki.

J. Phys. Soc. Japan, Vol. 14, No. 5, 578-83 (May, 1959).

Abrupt increases accompanying the elevation of temperature were observed in the line widths of the pure quadrupole resonance spectrum of 1,2,3-trichlorobenzene and hexachlorobenzene. The results suggest a possibility of reorientational motion of these molecules in temperature ranges far lower than the melting points. In consideration of the hexagonal symmetry of hexachlorobenzene, it is concluded that a reorientational motion occurs around the hexagonal axis of the molecule. Its hindering potential barrier was estimated at $12.6 > W \geq 9.9$ kcal/mole from pure quadrupole resonance alone. Although 1,2,3-trichlorobenzene has no symmetry about the normal axis of the molecular plane, measurements of proton magnetic resonance and dielectric constant, in addition to the pure quadrupole resonance, suggested the possibility of reorientational motion around the normal axis of the molecule, which covers only two neighbouring equilibrium positions. From temperature dependence of the line width of the pure quadrupole resonance spectrum, the mean height of its hindering potential barrier was estimated at $6.0 > W \geq 5.0$ kcal/mole.

MECHANICAL PROPERTIES OF SOLIDS

5

18235 DETERMINATION OF THE STATIC AND DYNAMIC ELASTIC PROPERTIES OF RESILIENT MATERIALS

R.S Jackson, A.J.King and C.R.Maguire.

Akust. Beihefte [Acustica], No. 1, 164-7 (1956).

A machine is described for the dynamic testing of materials resilient mountings. Results on typical materials are given over the range of frequencies from 1 cycle in 10 minutes to values in the lower audio register. The effects of wave motion in soft rub have been investigated for two samples using the high frequency apparatus described. Measurements of creep and incremental stiffness are given for three types of material over a period of two years.

53

18236 NEW DYNAMIC METHOD FOR MEASUREMENT OF ELASTIC MODULUS AND THE CAPACITY FOR DAMPING.

R.Cabarat.

Akust. Beihefte [Acustica], No. 1, 200-4 (1956). In French.

A dynamic method is described for the determination of ela modulus and damping which can be used up to a temperature of The excitation is made electrostatically. Non-conducting materi are given a conducting surface. The logarithmic decrement is c culated from the resonance and decay curves. The sensitivity of the method is shown from some examples of measurements. Th construction of an elasticity meter is given.

5

18237 COHESIVE FORCES IN LITHIUM FLUORIDE AND PERICLASE (MgO).

C.Susse and B.Vodar.

C.R. Acad. Sci. (Paris), Vol. 250, No. 23, 3825-7 (June 8, 1960). In French.

Experimental data for the elastic constants of LiF and MgO previously presented are compared with calculated values obtain using the method of Leibfried and Hahn. J.W Le

53

18238 DETERMINATION OF ELASTIC, ANELASTIC AND PLASTIC COMPONENTS OF UNIAXIAL TENSILE STRAIN. I. TESTS ON COPPER.

M.N.Mitra and S.N.Dutta.

J. Assoc. Appl. Physicists, Vol. 4, No. 4, 152-8 (Dec., 1957).

Results are discussed of tension tests on copper specimens t study the relations of stress with the three components of strain. viz., elastic strain, anelastic strain, and permanent plastic strai The test results are compared with the simplified relations suggested by Karunes (1956).

5

18239 DETERMINATION OF ELASTIC, ANELASTIC AND PLASTIC COMPONENTS OF UNIAXIAL TENSILE STRAIN. II. TESTS ON BRASS.

M.N.Mitra.

J. Assoc. Appl. Physicists, Vol. 5, 36-9 (1958).

The methods of Pt I are applied to two kinds of brass: low-strain-hardening and high-strain-hardening.

53

18240 ELASTICITY AND INTERNAL FRICTION OF BISMU

F.M.Saleh and Y.L.Yousef.

Proc. Math. Phys. Soc. Egypt, No. 22, 143-54 (June, 1958).

Young's modulus E and the internal friction Q^{-1} were studie by a transverse vibration method at low sonic frequencies in thr varieties of annealed bismuth, namely: the monocrystalline, the polycrystalline and the ductile metal. It was found that, in the temperature interval -80° to 200°C., the variation in Q^{-1}, though very pronounced in the low temperature region, is rather slight between 20° and 200°C., being in general a mild increase with evidence of a small relaxation peak in ductile and in polycrystall specimens, possibly due to enhanced grain boundary diffusion an having an activation energy of about 15 Kcal/mol in both. Strong strain amplitude dependence of E and of Q^{-1} is noticed in the str range of 10^{-6} and is correlated with dislocation mobility. The lo activation energy for grain boundary diffusion is supposed to be mainly due to vacant lattice sites.

539.3

41 INVESTIGATION OF THE MECHANICAL PROPERTIES
OF SOLIDS, ESPECIALLY METALS, AT TEMPERA-
OF 4.2°K AND BELOW. IV. THE MECHANICAL PRO-
ES OF COPPER, NICKEL, LEAD, CADMIUM, α-BRASS,
LEXIGLAS AT TEMPERATURES OF 4.2°K AND BELOW.
yavin and A.V.Stepanov.
erdogo Tela, Sbornik [Supplement] I, 241-50 (1959). In
n.
r previous work, see Abstr. 1867 of 1960. Reports the re-
f an investigation of the mechanical properties of 99.9%
opper, 99.94% nickel, 99.998% lead, 99.98% cadmium and of
s polycrystals, as well as of Plexiglas (polymethylmetha-
) at 300°, 78°, 4.2° and 1.6°K. The investigation included
–strain curves, type of fracture, tensile strength, yield point
ongation. Strong temperature dependence of the mechanical
ties of all these solids, except cadmium and Plexiglas, was
ed at 4.2-1.6°K. A.Tybulewicz

539.3

42 RECOVERY OF MECHANICAL PROPERTIES OF
IRRADIATED ROCKSALT AFTER NORMALIZING
LING. B.V.Budylin and A.A.Vorob'ev.
erdogo Tela, Sbornik [Supplement] II, 242-4 (1959). In Russian.
ter annealing at 400°C for 2 hours, rocksalt irradiated in a
r reactor (thermal neutron flux 5×10^{18} neutron/cm^2) re-
its initial tensile strength, elastic limit, plastic properties
crohardness. A.Tybulewicz

539.3

43 CALORIMETRIC MEASUREMENT OF ULTRASONICALLY
PRODUCED STRAINS IN SOLIDS.
est and N.G.Einspruch.
ust. Soc. Amer., Vol. 32, No. 9, 1160 (Sept., 1960).
n experiment for the calorimetric determination of the strain
ed in a solid material at low temperature by a megacycle
ncy ultrasonic wave is proposed. A calculation is presented
er to demonstrate that if the strain amplitude is of a magni-
equently estimated, it should be readily measurable.

539.3

44 STRESS AS A REDUCED VARIABLE: STRESS
RELAXATION OF SBR RUBBER AT LARGE STRAINS.
andel and P.J.Stedry.
l. Phys., Vol. 31, No. 11, 1885-91 (Nov., 1960).
tress relaxation measurements on SBR were carried out at
ratures from −5 to +60°C and at initial strains of up to 550%.
ffects of strain and time were found to be factorable, so that
ochronal stress–strain curve may be written as a modified
's law with a time dependent modulus: $S = E(t)\, ef(\alpha)$, where
an appropriate function of the strain. By defining a strain-
ed stress $S^* = S/F(\alpha)$, i.e. a strain-reduced modulus
$= E(t)f(\alpha)$, it can be shown that Ferry's method of reduced
bles may be extended to large deformations. An appropriate
function was obtained from the empirical Martin–Roth–
er equation as $f(\alpha) = \alpha^{-2} \exp A(\alpha - \alpha^{-1})$ with $A = 0.40$. Although
not yet be certain that A is truly a constant and the same for
astomers, this equation has the advantage of being valid right
the breaking strain.

539.3

245 INTERNAL FRICTION OF LEAD. II.
Y.Hiki.
ys. Soc. Japan, Vol. 14, No. 5, 590-6 (May, 1959).
For Pt I, see Abstr. 2973 of 1959. The experimental results
e internal friction of lead single crystals are discussed on
asis of the dislocation theory. At low temperatures, the depen-
es of the internal friction on the strain amplitude and the fre-
cy are well explained with the pinned-down dislocation model.
pinning of dislocations by point defects is also verified by
ysing the change of the amplitude dependence of the internal
ion produced by annealing the specimen. The exponential in-
se of the internal friction with increasing temperature is con-
red to be due to the thermal break-away of the dislocations
the pinning points. On the assumption that the Cottrell force
between the pinning impurity atom and the dislocation, some
e unknown quantities of a crystal can be determined as follows:
cation density is 1.03×10^{8} cm^{-2}, loop length of dislocation
ork 1.71×10^{-4} cm, and mean distance between impurities on
cation 2.85×10^{-5} cm. Above a certain temperature (about 300°K) the internal friction decreases with increasing strain amplitude, being the reverse of the behaviour at low temperatures. This phenomenon is interpreted as due to the impurity-pinning becoming ineffective at high temperatures and the formation of jogs at the network pinning points of the dislocations contributing to the internal friction.

539.3

18246 SOME OBSERVATIONS OF THE ANELASTICITY OF GLASSES. I.Mohyuddin and R.W.Douglas.

Phys. Chem. Glasses, Vol. 1, No. 3, 71-86 (June, 1960).

The damping of torsional vibrations in fibres of glass about 1 mm diameter was measured in a simple apparatus over a temperature range from −100°C to +450°C. The glasses investigated included binary silicate glasses containing lithium, sodium, potassium and lead, mixed alkali glasses containing sodium and potassium, a commercial soda–lime–silica glass and soda–lime–silica glass containing only 2% CaO. The variation of the damping with temperature follows a general pattern for all glasses; there is a background absorption of energy which is nearly independent of temperature at low temperatures and which increases rapidly at higher temperatures. Superimposed on this background are two peaks; of these peaks the one which occurs at low temperatures is thought to be due to stress-induced diffusion of the alkali ions. This peak is, of course, absent in glasses which contain no alkali. The second peak is shown to be due, probably, to the stress-induced diffusion of oxygen ions. A tentative discussion of the origin of the background absorption is included.

539.3

18247 DYNAMIC-ELASTIC BEHAVIOUR OF FOAMED PLASTICS. G.W.Becker.

Acustica, Vol. 9, No. 3, 135-43 (1959). In German.

Different methods are described for determining the dynamic Young's and dynamic shear moduli of foamed plastics in the range 0.1 to 100 c/s — for harder substances up to 1000 c/s. In estimating the elastic modulus on short cylindrical probes with attached end surfaces the influence of the shape of the probe for given Poisson's ratio is considered theoretically and tested experimentally. The results obtained on a series of different materials can be explained in terms of a simple model for closed and open mesh foamed material.

539.3

18248 DEPENDENCE OF MECHANICAL Q AND YOUNG'S MODULUS OF FERROELECTRIC CERAMICS ON STRESS AMPLITUDE. R.Gerson.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1297-1301 (Oct., 1960).

The effects of stress amplitude on the mechanical properties of several barium–titanate and lead–titanate–zirconate compositions were studied. The mechanical Q was found to decrease to about $\frac{1}{3}$ of its low-signal value at a dynamic stress of about 1500 lb/in^2. No further decrease occurred with stress up to about 4000 lb/in^2, the limit of these tests. Young's modulus decreased by about 5% in materials used in power transducers, and by about 25% in special compositions having low coercive force. It is concluded that the mechanical quality at the highest stress amplitude is still sufficiently high so that it will not seriously affect the efficiency of a well-matched acoustic transducer.

539.3

18249 EFFECT OF PRESSURE ON THE DYNAMIC SHEAR BEHAVIOR OF POLYISOBUTYLENE. A.W.Nolle.

J. appl. Phys., Vol. 31, No. 9, 1694-5 (Sept., 1960).

Measurements were made of the velocity and absorption coefficients of transverse waves generated in specimens of polyisobutylene at a frequency of 2 Mc/s. The specimens were tested in ethyl alcohol at pressures of up to 21 000 lb/in^2. The velocity rose with increase of pressure, a typical result being from 6×10^5 to 9×10^5 cm/sec over the full range of pressure while the absorption coefficient fell from 500 to 300 dB/cm. The results are analysed to evaluate dT/dP for constant molecular jump rate, constant jump rate implying constant dynamic modulus or constant elastic-wave propagation constants. The results indicated values of dT/dP of 0.010 deg C/atm from the absorption data and 0.015 deg C/atm from the velocity data, and these agreed reasonably well with data obtained by other investigators. It seems likely that the rate-determining mechanisms operating in both shear and volume processes are the same. A.C.Whiffin

539.3

18250 DYNAMIC MECHANICAL PROPERTIES OF HIGH POLYMERS AND THE IMPORTANCE OF THEIR STUDY. J.Prakash.

J. sci. industr. Res., Vol. 18A, No. 9, 404-13 (Sept., 1959).

Various methods employed in the determination of these properties are summarized with special reference to textiles, and their limitations are pointed out. The dependence of dynamic Young's modulus on the static strain applied to the specimen as well as on the dynamic strain-amplitude is discussed for yarns of different structures with a view to showing the possibility of dynamic determination in solving the problems of yarn geometry which, otherwise, are too complicated to be solved mathematically. Also, the dependence of dynamic modulus on structural order (orientation and crystallinity) is shown, and coupled with X-ray diffraction techniques, dynamic modulus determination may provide information about the changes in orientation and crystallinity at different stages of processing of artificial fibres. The relationship between static and dynamic measurements is discussed, and the fact that dynamic modulus, if determined at high frequency will permit the specimen to undergo only elastic elongation, is shown to be useful in determining the contribution of the immediate elastic component, primary creep and secondary creep in the total strain when a body is subjected to a particular load under static conditions.

539.3 : 534.21

18251 LONGITUDINAL WAVE PROPAGATION IN STRETCHED POLYMERS. P.Mason.

J. appl. Phys., Vol. 31, No. 10, 1706-8 (Oct., 1960).

The wave equation is derived for the propagation of longitudinal waves along a stretched filament of a highly elastic material. It is found that the tension in the filament reduces the effective modulus by twice the product of Poisson's ratio and the tensile traction, leaving the internal viscosity term unchanged. This result is illustrated by measurements of continuous 1 kc/s wave propagation in natural rubber at 50°C, where the damping is small ($\tan \delta < 0.1$). An alternative derivation is given for the purely elastic case of zero damping without restriction upon the amplitude. The "equilibrium" or "static" Young's modulus is obtained for extensions up to about 600% from the slope of the equilibrium stress—strain curve and used to predict the corresponding wave velocities from the wave equation for zero damping. The predicted velocities are slightly higher — by up to about 10% — than the measured velocities. It is shown that the deviations could arise from differences in rate of strain between the wave-propagation and the stress—strain measurements. At the higher extensions the rubber is very hysteretic for large deformations, and the Young's modulus governing the small-amplitude wave progagation is shown to relate substantially to the loading branch of the stress—strain curve.

539.3

18252 MECHANICAL RESONANCE DISPERSION AND PLASTIC FLOW IN CRYSTALLINE SOLIDS. E.R.Fitzgerald.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1270-89 (Oct., 1960).

An explanation is given for the mechanical resonance dispersions observed at audio-frequencies in many crystalline solids. The resonances are considered to result from alternating simultaneous slip occurring on transient slip planes with mean lifetimes of 10^{-2} to 10^{-4} sec. The slip along such planes is opposed by displacement-dependent, velocity-dependent, and acceleration-dependent stresses. These last two stresses are found to be of magnitudes which can result from the interchange of atoms across a slip plane with a consequent decrease of momentum of the fast moving (slipped) part of the sample undergoing deformation. If the rate of transfer is independent of the slip process, a velocity-dependent (viscous) stress results, but if some of the atoms are induced to transfer as a direct result of the slip itself, then an acceleration-dependent stress is present. These slip-planes, because of their sudden formation, short lifetimes, and inertial coefficients, do not contribute to the static or ultrasonic compliance, but do affect the dynamic compliance at audio-frequencies. The transient slip planes are supposed to be generated by the movement of dislocations across the sample. Thus, a concept of combined consecutive and simultaneous slip is suggested in which dislocations remain an essential part of the mechanism but are not the sole source of deformation. An interesting consequence of the theory is that a critical stress for plastic flow or, alternatively, for brittle fracture can be predicted from values of the dynamic compliance (or modulus). Predicted values of critical stress (for both single crystals and polycrystalline metals) made from the dynamic modulus at 100 c/s are much closer to the observed values than those made on the basis of either the static or ultrasonic moduli. In particular, it is found that the dicted values for brittle fracture stress agree almost exactly observed breaking stresses for single crystals of sodium chlo germanium, glycine sulphate, and, at two temperatures and or tions, for natural quartz crystals. The occurrence of negative absorption or induced emission is discussed, and a means of erating sustained, self-excited, audio-frequency oscillations i crystalline solid is outlined. The possibility of mechanical fa at an intrinsic material resonance is considered briefly and s other aspects of the mechanical behaviour of crystalline solid also examined.

18253 TENSILE DEFORMATION OF ALUMINIUM SINGL CRYSTALS AT LOW TEMPERATURES.

W.F.Hosford, Jr, R.L.Fleischer and W.A.Backofen.

Acta metallurgica, Vol. 8, No. 3, 187-99 (March, 1960).

Tension tests on aluminium single crystals of approximat [001], [111], [112] and [123] axial orientations were made at 4. 200 and 273°K. It was a general observation that the hardenin passed through a maximum and then decreased continuously w increasing stress, the decrease being less rapid at the lower temperatures. There were no findings, under any circumstanc a constant stage II slope in the stress-strain curves. At 273°K after initially rapid hardening, [001] crystals deformed primar operation of two slip systems with conjugate relationship; mult necks were formed but the accompanying lattice rotation preve failure by necking until large strains. At lower temperatures four stressed slip directions were active in the [001] crystals hardening continued to higher stresses. With the four directio two perpendicular sets of Lomer—Cottrell barriers could form contrasted to one set at 273°K, thus producing greater hardeni Slip markings at the lower temperatures tended to follow {110} traces, but this may be explained by a fine mixture of cross sl on two {111} planes, necessary to avoid the barriers. In [111] crystals, approximately equal operation of the three favoured directions at all temperatures prevented lattice rotation and maintained a high hardening rate.

18254 TENSILE PROPERTIES OF Cu WHISKERS. F.X.Eder and V.Meyer.

Naturwissenschaften, Vol. 47, No. 15, 352-3 (1960). In German

A critical shear stress inversely proportional to the squar the diameter and a plastic flow stress inversely proportional t diameter of the whisker were found. These results agree with Brenner's (Abstr. 3772 of 1957) for the former but not for the No explanation is offered for the discrepancy. J.E.C.

18255 LOW TEMPERATURE CREEP OF ROCK SALT SINGLE CRYSTALS. R.Strumane and W.Dekeyser.

Acta metallurgica, Vol. 7, No. 7, 520-1 (July, 1959).

The behaviour of rocksalt single crystals under constant lo at 35°C was examined on cylindrical specimens of 5 mm diame and 20 mm length. The extension was measured optically by m of two mirrors. The specimen was given a final etch to remove outer layers of the central part, and then immersed in a bath o degassed paraffin maintained at a constant temperature, and pl in a constant temperature room. Low loads gave no effect. At from 250 g mm^{-2} upwards an initial jerky movement was pro the period between the jerks being too small for measurement. Subsequently, smooth creep began. Results are given graphical for loads of 250, 300, 350, and 400 g mm^{-2}. R.V.C

18256 CREEP IN FACE-CENTRED CUBIC METALS WIT SPECIAL REFERENCE TO COPPER.

P.Feltham and J.D.Meakin.

Acta metallurgica, Vol. 7, No. 9, 614-27 (Sept., 1959).

The equilibrium creep rate of oxygen-free high-conductivit copper (99.99%) of constant grain size subject to constant stres in vacuo in the range 400-700°C, was found to satisfy the relati $\partial\epsilon/\partial t = A_0(T) \exp[-(H - q\sigma)/kT]$. Two sets of the parameters and q were however required at any given temperature, one bel and one above a critical tensile stress σ_c (T), above which Cott Lomer locking appeared to become a less effective impediment slip than at lower stresses. Vacancies travelling along disloca from grain boundaries to jogs are thought to assist the climb o edge dislocations, which process seems to be rate determining. activation energies H and H' (below σ_c') are therefore reduced

ue expected for self-diffusion to 32 and 28 kcal/g atom,
tively, which are close to the activation energy for vacancy
ion. Cross-slip and polygonization appear to take place in the
ent stage of creep. In single crystals H was found to be equal
activation energy for self-diffusion (49 kcal/g atom) over the
emperature range.

539.3

57 PLASTIC ANISOTROPY OF LiF AND OTHER ROCKSALT-TYPE CRYSTALS. J.J.Gilman.

netallurgica, Vol. 7, No. 9, 608-13 (Sept., 1959).
he stresses needed to cause $\langle 110\rangle$ dislocations to move on
as compared with $\{110\}$ planes have been measured in torsion
n LiF and in potassium halide crystals. Glide is much more
ult on $\{100\}$ planes than on $\{110\}$ planes in LiF, except for
ratures above about 400°C. It is shown that the ease of $\{100\}$
ncreases relative to $\{110\}$ glide through the series KCl →
KI and that PbTe prefers to glide on $\{100\}$ planes. Thus $\{100\}$
seems to be favoured by high ionic polarizability as Buerger
uggested. These results show that the atomic structures at
res of dislocations play an important role in the behaviours of
halide crystals.

539.3

258 STUDY OF NONUNIFORMITY OF PLASTIC DEFORMATION IN MONOCRYSTALS BY MEANS OF X-RAY OBEAMS. E.V.Kolontsova and I.V.Telegina.

allografiya, Vol. 4, No. 4, 587-9 (July-Aug., 1959). In Russian.
sh translation in: Soviet Physics—Crystallography (New York),
, No. 4, 547-9 (April, 1960).
iscusses some of the difficulties in using microbeam methods.
J.E.Caffyn

539.3

259 THE EFFECT OF ALLOYING ADDITIONS ON THE MAGNITUDE AND TEMPERATURE DEPENDENCE OF YIELD POINT. V.A.Pavlov and I.A.Pereturina.

Metallov i Metallovedenie, Vol. 9, No. 2, 248-57 (Feb., 1960).
ssian.
The problem of the effect of alloying additives on the behaviour
oys under load has been extensively studied. A critical analysis
ese investigations, supported by new experimental evidence
ing to Ni—Co alloys, leads the authors to the conclusion that
ges in the character of the deformation processes in pure metals,
ed by the introduction of alloying elements, cannot be explained
rms of changes in the binding energy. Both the theoretical
derations and experimental evidence indicate that the effect
e alloying additive on the resistance to deformation can be
tatively explained on the basis of (a) the interaction between
cations and impurity atoms, as postulated by Suzuki and
ell, (b) non-uniform concentration (of the K-state type) of the
rity atoms, and (c) redistribution of atoms in the field of
s of a moving dislocation, as postulated by Shoek. Additives
cause large, static distortions of the lattice have also the
marked strengthening effect. Regarding the Ni—Co alloys in
the crystal lattice distortions, caused by the Co atoms, are
ively small, the resistance to deformation of these alloys is
ted to a considerable degree by the disorder—order transform-
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M.H.Sloboda

539.3

8260 PROPERTIES OF TERNARY METAL SYSTEMS. I. MICROHARDNESS OF TERNARY ALLOYS TIN—IUM—ALUMINIUM. V.K.Semenchenko and N.P.Dogadkina.

Metallov i Metallovedenie, Vol. 9, No. 2, 265-9 (Feb., 1960).
ssian.
The concentration dependence of microhardness of 33 Sn-based
s, containing up to 2.5 at % of surface-active (Na) and/or
ace-passive (Al) metal, was studied. Although the microhardness
eased with increasing content of either alloying additive, the
lts indicated that it should be possible to prepare an alloy with
Al content so adjusted that the microhardness of the alloy would
dependent of its Na concentration. These "buffer" character-
s, displayed by the Sn—Na—Al alloys in respect of their micro-
ness, are opposite to those in respect of their surface tension
h can be made independent of the Al content by selecting a
ect Na concentration.
M.H.Sloboda

539.3

18261 PROPERTIES OF TERNARY METAL SYSTEMS. II. ON THE SIMULTANEOUS EFFECT OF SURFACE-ACTIVE AND SURFACE-INACTIVE ADDITIVES ON MICROHARDNESS OF TIN. V.K.Semenchenko and M.Saidov.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 270-3 (Feb., 1960).
In Russian.

Microhardness of Sn—Te—Al alloys, containing 0.1 at % Al, and Sn—Te—Zn alloys, containing 0.05 at % Zn, was found to practically unaffected by the variation of their Te content. Although no plausible explanation of the "buffer" characteristics of the alloys studied can be offered at this stage, they are probably associated with the difference in the mechanism of the variation of microhardness due to the presence of the surface-active and surface-inactive metals. Since stresses, caused by these additives, are associated with the dilation and contraction of the crystal lattice, respectively, the effect of one may be cancelled by that of the other.
M.H.Sloboda

539.3

18262 ON THE PART PLAYED BY DISTORTIONS OF THE SECOND ORDER IN STRENGTHENING OF METALS.

A.I.Il'inskii, V.M.Kardonskii and M.D.Perkas.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 294-9 (Feb., 1960).
In Russian.

The variation of the magnitude of type II distortions and the size of the regions of coherent dispersion on heating sputtered and bulk (distorted) specimens of Ni and a Fe—Si alloy were studied by X-ray diffraction. The results confirmed the view that, although work-hardening of metals is always accompanied by the formation of type II distortions, the resistance of a metal to plastic deformation is not determined by their magnitude. M.H.Sloboda

539.3

18263 THE TEMPERATURE DEPENDENCE OF THE FLOW STRESS OF AN AGE-HARDENED ALLOY. A.Kelly.

Acta metallurgica, Vol. 7, No. 12, 811-12 (Dec., 1959).

The resolved critical shear stress in Al—Cu alloys aged to contain Guinier—Preston zones of the first kind is discussed. It is concluded that there is a short range interaction between dislocations and the zones, and that the increase in flow stress at low temperatures is at least in part due to the stress needed to force the dislocations through the zones. H.Mykura

539.3

18264 DISPERSED PARTICLE HARDENING OF ALUMINUM—COPPER ALLOY SINGLE CRYSTALS.

D.Dew-Hughes and W.D.Robertson.
Acta metallurgica, Vol. 8, No. 3, 147-55 (March, 1960).

Single crystals were grown in aluminium—copper alloys containing from 3 to 5% Cu. These crystals were strained in tension after receiving heat treatments designed to develop $CuAl_2$ particles of varying sizes and distributions. Values of the critical resolved shear stress were found to be inversely proportional to the mean spacing between particles, in accordance with Orowan's theory. Fisher, Hart and Pry's theory that dislocation rings formed around the particles during deformation make a large contribution to work hardening, has received confirmation from the experimental results on these crystals. While a crystallographically defined critical resolved shear stress was observed, deformation took place mostly by multiple slip, the external characteristics of the deformation being similar to those of polycrystalline material.

539.3

18265 THE MECHANISM OF HARDENING IN AGED ALUMINUM—COPPER ALLOYS.

D.Dew-Hughes and W.D.Robertson.
Acta metallurgica, Vol. 8, No. 3, 156-67 (March, 1960).

Single crystals were grown in aluminium—copper alloys containing from 1 to 5% Cu. Crystals were tested in tension after an air-quench from the solution-treating temperatures. The ageing behaviour of crystals containing 4% Cu was studied by X-rays and by hardness tests. 4% Cu crystals were tested in tension after ageing for various times at 130° and 190°C. Crystals in all stages of ageing obeyed the critical resolved shear stress law, though crystals containing θ' particles deformed by multiple slip in the same manner as that previously found for overaged crystals. Strengthening due to the presence of Guinier—Preston zones was calculated by summing the contributions from Mott and Nabarro's coherency strain strengthening, Kelly's chemical strengthening and the strength of the residual solid solution. The calculated values of critical resolved shear stress are in agreement with measured values on crystals aged for 2 (GP-I) and 10 (GP-II) days at 130°C and for 5 (GP-I) days at 110°C.

539.4

18266 DISPERSION HARDENING.

W.H.Meiklejohn and R.E.Skoda.
Acta metallurgica, Vol. 7, No. 10, 675-6 (Oct., 1959).

The effect of particle size and spacing of a dispersed second phase on the yield strength of a metal was studied in the Hg—Fe system. Fe was introduced into liquid Hg by electrodeposition and Fe particles of sizes between 50 and 1000 A were produced by heat treatment. Specimens were tested at 77°K. Yield strength was found to depend only on the ratio of particle diameter to particle spacing. H.Mykura

539.4

18267 DETERMINATION OF THE ANISOTROPY OF MICROHARDNESS OF BERYLLIUM CRYSTALS.

R.I.Garber, S.Ya.Zalivadnyi and F.S.Gorokhovatskii.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 274-8 (Feb., 1960).
In Russian.

The method consisted in taking a series of hardness measurements at points contained within a segment of the surface of a spherical single crystal. It was shown that the microhardness of Be (99.4% pure) is represented by an ellipsoid with an axial ratio of 0.6, the long axis parallel to the crystal axis C_6 and the short axis perpendicular to C_6, being 350 and 217 kg/mm^2, respectively. M.H.Sloboda

539.4

18268 THE HARDENING OF LITHIUM FLUORIDE BY ELECTRON IRRADIATION.

A.D.Whapham and M.J.Makin.
Phil. Mag. (Eighth Ser.), Vol. 5, 237-50 (March, 1960).

A study was made of the effect of 1 MeV electron irradiation on the mechanical properties of lithium fluoride single crystals tested in compression. The yield point, σ, was shown to vary with the irradiation dose, ϕ, according to the law $\sigma = \sigma_u + A[1 - \exp(-E\phi)]^{1/2}$, where σ_u,A and B are constants. This relationship was derived theoretically by considering the passage of dislocations through radiation induced obstacles dispersed in the slip plane, together with the capture of point defects by existing obstacles. The empirical relationship $\sigma = k\phi^{1/3}$, previously used for radiation hardening in metals, is capable of representing only the medium dose results, but clearly does not fit at either low or high doses. A new mechanism of cracking in heavily irradiated lithium fluoride, similar to that proposed by Cottrell for alpha iron, was observed. With compression along a [001] axis, cracks are initiated at the intersections of orthogonal {110} type slip planes and extend on the (100) cleavage plane passing throughtthe intersection and parallel to the compressio axis.

539.4

18269 DISCUSSION OF "SHEAR ALONG GRAIN BOUNDARIES OF AN ALUMINIUM—10% ZINC ALLOY DEFORMED AT ROOM TEMPERATURE". E.C.W.Perryman.

Acta metallurgica, Vol. 7, No. 9, 648 (Sept., 1959).

A conclusion by Chaudhuri et al. (Acta metallurgica, Vol. 7, No. 1, 60, Jan., 1959) that an Al—10% Zn alloy is anomalous because grain boundary shear takes place at 0.33 of the absolute solidus temperature is probably not valid. The experiments may have been carried out on material which was not single-phase and evidence is presented to support this view. A.E.Kay

539.4

18270 THE EFFECT OF HYDROSTATIC PRESSURE ON THF SHEAR STRENGTH OF SOLIDS.

L.F.Vereshchagin and V.A.Shapochkin.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 258-64 (Feb., 1960).
In Russian.

The effect of hydrostatic pressure, $P \leq 5 \times 10^5$ kg/cm^2, on the shear strength, τ, of Li, Na, K, Cu, Ag, Mg, Zn, Ge, In, Sn, Cd, Zr, Sb, Bi, V, Nb, Ta, Te, Cr, W, Fe, brass, and several types of steel was studied. At high P the τ(P) relationship ceased to be linear and local deflections were observed on curves obtained for metals that undergo polymorphic transformations. In several cases τ, measured under very high P, equalled or even exceeded the theoretical strength of the metal at atmospheric pressure. Thus, Fe tested at $P = 3 \times 10^5$ kg/cm^2 had $\tau = 750$ kg/mm^2. M.H.Sloboda

5

18271 MECHANICAL PROPERTIES OF SPECIAL STEELS OTHER ALLOYS UNDER HIGH HYDROSTATIC PRESSURES. V.A.Shapochkin.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 303-5 (Feb., 1960)
In Russian.

Shear strength, τ, of a Ti alloy, a Cr—Ni steel, a heat-resis turbine blade alloy, steel 45, and technical Fe was measured und hydrostatic pressure $P \leq 5 \times 10^5$ kg/cm^2. τ increased with increasing P throughout the investigated range, the initial rate of increase being highest for the Ti alloy and lowest for Fe. At a certain pressure, different for each alloy, the rate of increase in became approximately the same for all alloys. M.H.Slob

5

18272 INVESTIGATION OF THE FORMATION OF TWINS PRODUCED IN METAL CRYSTALS UNDER THE ACTION OF CONCENTRATED LOADS.

V.M.Kosevich and V.I.Bashmakov.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 288-93 (Feb., 196
In Russian.

A diamond pyramid microhardness tester was used as the n of applying a concentrated load to Bi, Sb, Bi—Sb, Bi—Sn and Bi— single crystals. The length, l, of twins produced under these co ditions was proportional to the diagonal, d, of the indentation, th intensity of twinning being thus given by the coefficient α in the equation $l = a + \alpha d$. In the case of homogeneous Bi—Sb alloys, α increased with increasing Sb content, the variation of α being similar to that of microhardness; at the Sb content >1%, α becan equal to that of pure Sb, and elastic twins were produced. α of t Bi—Sn and Bi—Pb alloys increased slightly in the 0-1% Sn and 0-1.5% Pb concentration ranges, remaining constant at higher co centrations of the alloying addition. M.H.Slob

53

18273 EFFECT OF REACTOR IRRADIATION ON THE TEN STRENGTH OF UNIAXIALLY ORIENTED POLYETH LENE TEREPHTHALATE. C.C.Hsiao and S.T.Chow.

J. appl. Phys., Vol. 31, No. 11, 1869-71 (Nov., 1960).

A series of uniaxially oriented polyethylene terephthalate fil irradiated in a nuclear reactor have been investigated. On the b of tensile studies the ultimate tensile strength is found to decrea as the dose of reactor irradiation increases. However, the ultim tensile strength is found to increase when the degree of molecula orientation increases. But after the samples have received a relatively high dose of irradiation the tensile strength approache practically zero. The X-ray diffraction scans of the nonirradiat samples with low degrees of orientation indicate very little crystallinity, whereas the very definite diffraction peaks associa with the irradiated and oriented samples indicate a definite trend toward crystallinity.

5

18274 EFFECT OF TEMPERATURE AND REACTOR IRRADIATION ON THE STRENGTH OF BIAXIALLY ORIENTED POLYETHYLENE TEREPHTHALATE.

A.Haynes and C.C.Hsiao.
J. appl. Phys., Vol. 31, No. 11, 1871-3 (Nov., 1960).

Samples of biaxially oriented polyethylene terephthalate irradiated in a nuclear reactor have been investigated at five temperature levels ranging from −150°F to 350°F. In general, from tensile studies, the ultimate tensile strength was found to decrease markedly to a relatively low magnitude upon receiving reactor irradiation dose having a thermal neutron bombardment component of 10^{18} n.v.t. and over. The modulus of elasticity for both the irradiated and nonirradiated samples was found to incre with the decrease of the temperature. The fracture surfaces of biaxially oriented polyethylene terephthalate samples obtained at −15°F are also recorded for reference.

53

18275 ON THE STRENGTH OF GLASS IN WATER VAPOUR F.R.L.Schoening.

J. appl. Phys., Vol. 31, No. 10, 1779-84 (Oct., 1960).

The bending strength of glass slides, which had the dimensio 38 × 6 × 0.16 mm, was measured at different relative pressures water vapour. The adsorption isotherms of water vapour on powdered glass, which had the same composition as the slides, w measured in a separate experiment. The reduction of the surfac free energy as function of the vapour pressure was calculated fr therms. The observed variation of the strength was compared e strength variation calculated from the reduction of the free energy. The Griffith equation for brittle fracture was relate strength and surface free energy. Two cases were ered: (1) the specimens were weakened by the reduction of face free energy and (2) the specimens were weakened by the ion of the surface free energy and by a deepening of the cracks. Both interpretations agreed with the experimental because, by using the Griffith equation, only the lower limits strength of the specimens could be calculated. It was found observed strength did not decrease steadily with increasing pressure, but had a secondary maximum at a relative re of about 0.2. The maximum reduction of the strength ponding to complete wetting with water was already reached at ive pressure of about 0.5. The ratio of the strength in ted water vapour to the strength in vacuum was found to be ndent of the surface damage of the specimens.

539.4

276 **STRENGTH IMPAIRMENT MECHANISM OF GLASS IN AQUEOUS SYSTEMS.** F.J.Radd and D.H.Oertle.

(London), Vol. 184, 976 (Sept. 26, 1959).

eports the tensile strengths of two glass fibre fabrics, ex- to water or to "wet cements" of pH 11 or 13 for various times.

D.G.Holloway

539.4

77 **STRENGTH OF ACID-ETCHED GLASS RODS.** B.A.Proctor.

(London), Vol. 187, 492-3 (Aug. 6, 1960).

da glass rods, 6 to 8 mm in diameter, were tested in bending. were tested in the condition as received, while others were usly subjected to various amounts of etching in a solution ning 15% of hydrofluoric acid and 15% of sulphuric acid. The ng strength increased with the amount of material removed etching process, the greatest strengths obtained, (4.5 − 5.0) × b/in^2., being close to the value obtained by Thomas for fine fibres. The experiments show how the low strength values lly obtained result from the presence of surface imper- ns.

A.C.Whiffin

539.4

78 **HIGH TEMPERATURE INTERCRYSTALLINE CRACKING.** L.L.Seigle.

metallurgica, Vol. 7, No. 6, 421-2 (June, 1959).

ramer and Machlin (Acta metallurgica, Vol. 6, No. 6, 454, 1958) have reported that the amount of grain boundary cracking kel strained at 920° C is proportional to the elongation and d that the data supports a mechanism of crack growth by grain ary sliding. It is suggested that the microstructural appear- of specimens strained at elevated temperatures frequently does pport this type of mechanism and the behaviour of deoxidized r is cited as an example. There is also evidence that inter- lar fracture can occur in ingot iron with practically no grain ary sliding. Two other explanations are advanced; either crack h by a process of ductile fracture along the grain boundary or h by the flow of vacancies from the grain boundary to the tip of ack due to the concentration of tensile stress at the edge of the

A.E.Kay

539.4

279 **THE MECHANISM OF CRACK PROPAGATION IN DUCTILE METALS.** H.C.Rogers.

metallurgica, Vol. 7, No. 11, 750-2 (Nov., 1959).

mechanism is proposed for crack propagation in ductile ls according to which such a crack is propagated by each grain ted (which behaves as a constrained single crystal) "gliding to e" as it is exposed to the crack, i.e. as it becomes a surface . Support is adduced from the work of Fried and Sachs, and of man.

J.Thewlis

539.4

280 **ON THE SHAPE OF CRACKS IN A MICROSCOPIC MODEL OF A CRYSTAL.** Yu.M.Plishkin.

Metallov i Metallovedenie, Vol. 9, No. 2, 178-83 (Feb., 1960). ssian.

Theoretical. One of the shortcomings of Griffith's theory of the f cracks in the brittle fracture is the assumption that cracks ertain type are always present in a stressed specimen; this es their inherent stability, a characteristic which Griffith's s do not possess. Using a microscopic model of a crystal, the conditions under which cracks can exist in crystals of this type are determined, as is the shape of the cross-section of the crack which corresponds to the minimum potential energy of the crystal.

M.H.Sloboda

539.4

18281 **ON THE CONDITIONS GOVERNING THE BRITTLE FRACTURE OF IRON SINGLE CRYSTALS.** H.K.Birnbaum.

Acta metallurgica, Vol. 7, No. 7, 516-17 (July, 1959).

The effectiveness of a mechanical twin boundary in causing cleavage fracture as a result of dislocation pile up is expected to depend on the ability of the boundary to prevent the passage of dislocations through it into the twinned lattice. It is shown that the brittle behaviour at −196°C corresponds approximately with the region in which the twin system $(\bar{1}12)[111]$ is expected to be dominant, while the region in which the system $(\bar{1}\bar{1}2)\ [111]$ is expected to operate corresponds to the orientation range for ductile behaviour. The differences in resolved shear stresses for these two twin systems are quite small for most orientations so it is suggested that the cleavage failure observed for all orientations examined at −253°C may be the result of the formation of twins of the system $(1\bar{1}2)\ [\bar{1}11]$ because of the increased stress required for twinning at this temperature.

A.E.Kay

539.4

18282 **A SYMMETRICAL FOURFOLD HELICAL FRACTURE IN TITANIUM OXIDE.** J.S.Jackson.

Nature (London), Vol. 187, 1104-5 (Sept. 24, 1960).

A very unusual fracture surface in a hot-pressed titanium dioxide rod is described. No explanation for the symmetrical form is put forward.

H.Mykura

539.4

18283 **THE FATIGUE OF METALS AT 1.7°K.** R.K.MacCrone, R.D.McCammon and H.M.Rosenberg.

Phil. Mag. (Eight Ser.), Vol. 4, 267-8 (Feb., 1959).

Extends previous experiments on copper and cadmium (Abstr. 3523 of 1958). Curves are given of fatigue stress against number of cycles to failure, which show no significant difference from the curves for 4.2°K. It is suggested that the tensile strength would also show no change.

R.Berman

539.5

18284 **AGEING AND HOT HARDNESS CHARACTERISTICS OF CERTAIN THORIUM ALLOYS.**

G.H.Bannister, R.C.Burnett and J.R.Murray.

J. nuclear Mater., Vol. 2, No. 1, 51-61 (March, 1960).

Ageing experiments at 500°, 600° and 700° C on thorium-rich thorium-aluminium and thorium-uranium alloys are described, together with the results of similar tests at 600° C on five more complex thorium alloys; hot hardness tests at temperatures up to 800° C have been made on three samples of thorium and on several Th-Al, Th-U and Th-Zr alloys in the as-cast, solution treated and aged conditions. Aluminium additions improved the hot hardness of thorium and the alloys showed considerable hardening due to precipitation of Th_2Al. The rate of ageing increased directly with aluminium content and with temperature while the maximum hardness for a given composition increased inversely with temperature. Little precipitation hardening was observed in thorium-uranium alloys containing up to 3 at% uranium and their hot hardness behaviour showed little significant improvement over unalloyed thorium. The results on thorium-zirconium alloys suggest that zirconium additions within the α-thorium solid solution range lead to solution hardening. In an alloy containing 22 at% zirconium hot hardness values, up to 600° C, were obtained after solution annealing in the β (body-centred cubic) phase-field than after solution treatment in the $(\alpha + \beta)$ field. Additions of aluminium and uranium in excess of the solubility limit restrict the grain growth of thorium at 1150° and 1200° C respectively.

539.6

18285 **WEAR OF THE HARD AND SOFT PHASES IN COBALT-BONDED TUNGSTEN CARBIDE.**

J.Golden and G.W.Rowe.

Brit. J. appl. Phys., Vol. 11, No. 11, 517-20 (1960).

It has previously been widely accepted that the normal wear pattern of cobalt-bonded tungsten carbide is a steady attrition of the soft matrix, leading to occasional loosening of hard carbide grains. This hypothesis seems to have been based on visual examination of autoradiographs of copper wire drawn through radioactive tungsten carbide dies. The present experiments show that autoradiographs of this type having a steady general level of blackening with local dense spots superimposed, are obtained if the copper surface is not sufficiently well prepared. On smooth surfaces uniform autoradiographic density is observed. Details measurements of the former type of autoradiograph have been made, showing first the short-lived tungsten activity and finally the long-lived cobalt activity. These refute the suggestion that the spots are carbide grains and that the general level is cobalt. The composition of the wear deposit in both is the same, and corresponds closely to the initial composition of the bonded carbide. The revised picture of steady continuous wear of both phases concurrently, accords with other experimental evidence quoted.

CRYSTALLOGRAPHY

CRYSTAL STRUCTURES

539.2 : 548

18286 INTERNATIONAL FEDOROV SESSION ON CRYSTALLOGRAPHY AT LENINGRAD.
N.V.Belov, B.K.Vainshtein, A.I.Kitaigorodskii, M.A.Porai-Koshits, S.A.Semiletov and N.N.Sheftal'.
Kristallografiya, Vol. 4, No. 5, 796-800 (Sept.-Oct., 1959). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 4, No. 5, 755-9 (May, 1960).

A summary of the proceedings of the International Conference on crystallography held in Leningrad on May 21-27, 1959 to commemorate the 40th anniversary of the death of the Russian crystallographer E.S.Federov. J.Iball

539.2 : 548

18287 A VERY SIMPLE WAY OF DEDUCING THE SPACE GROUPS. N.V.Belov and R.F.Klevtsova.
Kristallografiya, Vol. 4, No. 4, 473-6 (July-Aug., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 448-51 (April, 1960).

A further note on the subject of simplifying the derivation of space groups (Abstr. 16249 of 1960). It is shown that by following the method of the earlier paper it is much easier to transform the space group symbols into two dimensional diagrams. J.Iball

539.2 : 548

18288 RELATION OF THE ANTISYMMETRY AND COLOUR SYMMETRY GROUPS TO ONE-DIMENSIONAL REPRESENTATIONS OF THE ORDINARY SYMMETRY GROUPS. ISOMORPHISM OF THE SHUBNIKOV AND SPACE GROUPS.
V.L.Indenbom.
Kristallografiya, Vol. 4, No. 4, 619-21 (July-Aug., 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 578-80 (April, 1960).

Shubnikov's antisymmetry group idea is used to show that all true antisymmetry groups derivable from a given symmetry group can be derived from one-dimensional real representations of that group and are isomorphous with that group. As an example the tables for the irreducible representations of the point groups are used to describe all the magnetic crystal classes. One dimensional complex representations give the colour symmetry groups, in which multiplication with a power of $\exp(2\pi i/n)$ represents change from one colour to another (n is the total number of colours).
C.Turner

539.2 : 548

18289 THE NATURE AND PROPERTIES OF TRANSITION METAL HYDRIDES. G.G.Libowitz.
J. nuclear Mater., Vol. 2, No. 1, 1-22 (March, 1960).

The basic chemical and physical properties of transition metal hydrides are reviewed with particular emphasis on the hydride phases rather than dilute solutions of hydrogen in metals. The review includes discussions of the phases present in metal-hydrogen systems, their crystal structures, pressure-composition-temperature relations, thermodynamic properties, and electrical and magnetic properties. The nature of transition metal hydrides is considered. Evidence is given to show that they are definite chemical compounds (rather than solid solutions) having some degree of ionic character. The large deviations from stoichiometry exhibited by these compounds can be explained on the basis of lattice defects.

539.2

18290 DETERMINATION OF PREFERRED ORIENTATIO POLYCRYSTALLINE METAL FOILS USING A SPUTTERING TECHNIQUE. R.S.Nelson.
Brit. J. appl. Phys., Vol. 11, No. 10, 475-7 (Oct., 1960).

The preferred crystal orientation of metal foils has been q litatively analysed by observingthe pattern produced when atom sputtered from the surface in a gas discharge are collected on plate.

539.2

18291 ON A COMPLEX RECRYSTALLIZATION TEXTURE IN 3% SILICON IRON. C.G.Dunn and C.J.McHargue
J. appl. Phys., Vol. 31, No. 10, 1767-70(Oct., 1960).

Components in a complex primary recrystallization texture which is a matrix texture for secondary recrystallization to the Goss texture in 3% silicon-iron strip, have been determined by axis-chart method of Jetter, McHargue, and Williams (Abstr. 41 of 1956). The results obtained are compared with former pole-figure results and found to include components not previously re or noted. It is found also that the components of the texture expl reasonably well the observed magnetic torque curve of the mate

539.2

18292 MORPHOLOGY OF POLYMER SINGLE CRYSTALS. D.H.Reneker and P.H.Geil.
J. appl. Phys., Vol. 31, No. 11, 1916-25 (Nov., 1960).

Evidence is presented indicating that polyethylene crystals grow in the form of hollow pyramids as well as lamellar crysta Modes of packing the folded molecules consistent with the nonpl structure are proposed. Observed electron diffraction patterns dark-field micrographs are related to the pyramidal morpholog Various sources are described for the screw dislocations which result in spiral growths on crystals of polyethylene and polyoxymethylene.

539.2 :

18293 CHAIN FOLDING AND FREE ENERGY DENSITY IN POLYMER CRYSTALS. A.Peterlin.
J. appl. Phys., Vol. 31, No. 11, 1934-8 (Nov., 1960).

Macromolecular chains in freely growing crystals very likely fold back at regular intervals in order to minimize the free energy density of the crystal. The surface energy contribution favours infinite thickness. The smearing out effect of int chain potential field, however, arising from the incoherent part fluctuation of neighbouring chains and increasing with the fold period, favours thin crystals. For sake of simplicity the longitudinal chain vibrations were considered in spite of the fact that actual crystals the main contribution most likely comes from rotational oscillations. Since the general character of smearing out effect is nearly the same in both cases the present results m be applied at least qualitatively. They fairly well represent the general trend of temperature dependence of polymer crystal thic ness and its change with intermolecular forces.

539.2 : 5

18294 TWINNING IN TANTALUM. R.W.Anderson and S.E.Bronisz.
Acta metallurgica, Vol. 7, No. 9, 645-6 (Sept., 1959).

Twins were observed in high purity Ta after impact deforma at room temperature. The twins had serrated edges similar to those of Neumann bands in iron. Increasing purity appears to increase the ease with which twins may be formed. J.Fra

539.2 : 5

18295 TWINNING IN COPPER ELECTRODEPOSITS. S.C.Barnes.
Acta metallurgica, Vol. 7, No. 10, 700 (Oct., 1959).

The twinning was shown to be dependent on current density orientation of the crystals. With rising current density on the (1 face twinning occurred more readily than on (100) face. Two Cu-solutions were used, similar results for equal faces were obtained. H.E.Sch

539.2 : 5

18296 SECOND CONFERENCE ON THE GROWING OF CRYSTALS. E.N.Slavnova and N.N.Sheftel'.
Kristallografiya, Vol. 4, No. 5, 804 (Sept.-Oct., 1959). In Russia English translation in: Soviet Physics — Crystallography (New York), Vol. 4, No. 5, 764-5 (May, 1960).

A summary of a conference on crystal formation held in Moscow on 23 March to 1 April 1959. It was attended by scientis

ussia and other Eastern European countries and from China. bjects discussed included the growing of commercial single ls and theoretical work in the field of seeding and crystal w.
J.Iball

539.2 : 548.5

97 ON THE THEORY OF RATE OF CRYSTALLIZATION. R.Kaischew.

hys. Hungar., Vol. 8, No. 1-2, 75-81 (1957). In German.
ie rate of crystallization of fault-free crystals is determined a calculational scheme of Becker and Döring based on physical lue to Strauski and the author. The emphasis is upon the for- of the two-dimensional "seeds" from which each new atomic grows.
J.W.Leech

539.2 : 548.5

98 EQUIVALENT STEPS AND PERIODICITY IN CRYSTAL GROWTH. F.Bukovszky.

hys. Hungar., Vol. 8, No. 1-2, 109-18 (1957). In German.
is claimed that the availability of surface sites with differing es may give rise to periodicities in crystal growth. These mitted to be unobservable but some connection with observed scopic periodicities is foreseen.
J.W.Leech

539.2 : 548.5

99 ON THE MECHANISM OF THE GROWTH OF QUARTZ CRYSTALS. G.Zimonyi.

hys. Hungar., Vol. 8, No. 1-2, 119-27 (1957). In German.
n a number of natural and synthetic crystals, after the ls have been etched, features become visible which are reted as growth figures. The etching is done by saturated vapour at 200°C. In addition small etch pits occur which entified with dislocations.
W.Bardsley

539.2 : 548.5

00 THE APPLICATION OF THE ROWLAND MECHANISM TO THE PROBLEM OF THE NUCLEATION OF NDARY CRYSTALS IN CUBE-TEXTURE COPPER.

erbraak.
netallurgica, Vol. 8, No. 2, 65-70 (Feb., 1960).
xperimental evidence is provided that the growth of large dary crystals with the Kronberg and Wilson orientations is ded by the formation of crystals with the orientation {111} during the secondary recrystallization of heavily twinned texture copper. The nucleation of the {111} ⟨112⟩ crystals is ned with the aid of the Rowland lattice model. The crystals e Kronberg and Wilson orientations are first and second order of the initially formed {111} ⟨112⟩ crystals.

539.2 : 548.5

301 SUBCRYSTALS IN LARGE VAPOUR-GROWN CRYSTALS OF TUNGSTEN.

ieck and H.A.C.M.Bruning.
netallurgica, Vol. 8, No. 2, 97-105 (Feb., 1960).
ingle crystals of tungsten, grown by decomposition of the de in the vapour phase, were investigated. A substructure een found both with X-ray and microscopic techniques. The entation between the subcrystals is at random and is therefore ent from that found in single crystals in recrystallized doped en wires. The occurrence of a substructure or even dendrite hes depends upon the circumstances during growth. The rows h pits on the photomicrographs of etched surfaces are of the nature as those found by other authors on tungsten prepared ifferent manner. Electron-microscope pictures of etched sur- sometimes reveal pyramid shaped etch hills and whisker-like es, which are supposed to be subcrystals grown with the highest ction, during temporarily favourable conditions.

539.2 : 548.5

302 EFFECT OF PRESSURE ON INTERMETALLIC LAYER GROWTH. L.S.Castleman.

metallurgica, Vol. 8, No. 3, 137-46 (March, 1960).
The effect of hydrostatic pressure on the kinetics of inter-llic layer growth in interdiffusing three-phase two component ms has been examined theoretically. A system has been ted for detailed analysis, in which the kinetics of layer growth ontrolled by equilibrium interface concentrations and by the sion coefficient in the growing intermetallic phase. An equation een derived which enables one to estimate the relative impor- to intermetallic layer growth of pressure-induced changes in iffusion coefficient and pressure-induced shifts in the interface boundary concentrations. Also, an estimate has been made of the importance of pressure-induced shifts in equilibrium concentrations in affecting the kinetics of growth of the $\epsilon(UAl_3)$ phase layer in the aluminium—uranium system and of the $\gamma(Ni_2Al_3)$ phase layer in the aluminium—nickel system. It is concluded that the pressure-induced increase in ϵ growth rate cannot be rationalized on the basis of shifts in the equilibrium concentrations. The pressure-induced decrease in growth rate of the γ phase is attributed primarily to a decrease in diffusion coefficient; equilibrium concentration shifts play a minor role.

539.2 : 548.5

18303 THE INFLUENCE OF IMPURITIES ON THE FIBROUS SUBSTRUCTURE OF ZINC SINGLE CRYSTALS.

P.Kratochvíl, P.Lukáč and M.Valouch.
Czech. J. Phys., Vol. 10, No. 1, 48-51 (1960). In German.

Reports on measurements of the dependence of the diameters of the fibrous substructures on the proportion of impurity in Zn single crystals with admixtures of Cd and Cu. The possibility of estimating the distribution coefficient is discussed.
J.W.Leech

539.2 : 548.5

18304 THE EFFECT OF THE INITIAL PURITY OF TIN ON THE PREFERRED DIRECTION OF CRYSTAL GROWTH.

V.O.Esin and A.A.Kralina.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 305-7 (Feb., 1960). In Russian.

The mode of solidification of two grades of Sn (99.95 and 99.998% pure) was studied. Whereas a ⟨110⟩ preferred orientation was observed in the columnar zone of the less pure metal, the orientation of the corresponding crystals in the pure ingot was distributed randomly along one side of the stereographic triangle between the ⟨110⟩ and ⟨100⟩ axes. The latter effect is explained by postulating that at sufficiently high rates of displacement of the solidification front its movement becomes non-uniform in time (pulsating), and the concentration of impurities in the liquid phase at the liquid/solid interface varies periodically in such a manner that the conditions favourable for the appearance of any given preferred orientation are never realized.
M.H.Sloboda

539.2 : 548.5

18305 THE LAMELLAR CHARACTER OF CRYSTALLIZATION AND SUB-STRUCTURE OF TIN OF VARIOUS DEGREES OF PURITY. V.O.Esin and A.A.Kralina.

Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 307-10 (Feb., 1960). In Russian.

The results of metallographic and X-ray examination of the solidification front, exposed by decantation of the liquid phase, confirmed the view that growth of a Sn crystal entails growth of a number of separate layers, leading to the formation of a lamellar sub-structure. Also discussed is the effect of impurities and of the degree of undercooling on the formation of cellular and striated sub-structures, observed in the course of the present investigation.
M.H.Sloboda

539.2 : 548.5

18306 GROWTH OF CESIUM CHLORIDE CRYSTALS FROM SOLUTION AND MELT. P.Avakian and A.Smakula.

J. appl. Phys., Vol. 31, No. 10, 1720-2 (Oct., 1960).

Large caesium chloride crystals were obtained from solution only upon addition of urea. These crystals, however, show NH_4^+ impurity. Since CsCl undergoes a phase transition between its melting point and room temperature, normal growing methods from the melt could not be used, but a modified ("double-run") Bridgman method yielded good results.

539.2 : 548.5

18307 TRANSFORMATION STUDIES OF GRAY TIN SINGLE CRYSTALS. R.G.Wolfson, M.E.Fine and A.W.Ewald.

J. appl. Phys., Vol. 31, No. 11, 1973-7 (Nov., 1960).

Measurements of the linear growth rate of white tin into thin single-crystal wafers of grey tin, over the temperature range 24.2° to 46.5°C, are presented. The rate is not a single-valued function of the temperature. Imposed upon the strong temperature dependence of the average rate is a variation which is well defined at a given temperature; the spread in the observed values decreases sharply with increasing temperature. The variation is attributed to two observed stress-relaxation processes: cleavage in the grey tin and plastic deformation, accompanied by recrystallization, in the white tin.

539.2 : 548.5

18308 IRRADIATION-INDUCED GROWTH OF α-URANIUM AS THE RESULT OF CORRELATED COLLISION PROCESSES. U.Gonser.

J. nuclear Mater., Vol. 2, No. 1, 43-50 (March, 1960). In German.

The correlated collision model is applicable to the interpretation of the irradiation-induced growth of α-uranium, and associated phenomena. In the neighbourhood of a fission spike the following processes occur preferentially in the three principal crystallographic directions: [100] — focusons; [010] — dynamic crowdions; [001] — high concentration of Frenkel pairs. The transition from anisotropic growth to isotropic swelling under irradiation, as observed at elevated temperatures, is a consequence of the loss of focusing of the correlated collisions. The grain size dependence of irradiation-induced growth, and the possibility of reducing it, are discussed. The existing models of growth (spike and diffusion models) are considered.

539.2 : 548.5

18309 OBSERVATIONS ON THE EFFECT OF SURFACE DIFFUSION ON THE GROWTH OF POTASSIUM CRYSTALS IN SUPERSATURATED VAPOUR.

W.Dittmar and K.Neumann.

Z. Elektrochem., Vol. 63, No. 7, 737-40 (1959). In German.

A drop-like single crystal of potassium was formed by the condensation of potassium on a silver wire. The potassium atmosphere was supersaturated and the velocity of growth of the crystal was investigated. Vigorous surface diffusion influences the velocity of condensation on different surface areas of a potassium crystal. The diffusion takes place from the crystal faces towards the round regions. Therefore the condensation coefficient becomes smaller than 1 for the faces and larger than 1 for the round regions. More extended round regions show a coefficient of condensation which is practically 1. A tangential growth of the faces is caused by diffusion too. This is an important fact for the development of a perfect crystal. Considering the applied supersaturation, the normal velocities of growth for faces and round regions are not different enough to create corners and edges. Considering the velocity of formation of a corner it is possible to calculate the product D . c_0 (D is the surface diffusion coefficient and c_0 is the adsorption density). This product is some orders of magnitude higher than the result calculated using standard theories for the calculation of D and c_0. Some possible explanations are given.

539.2 : 548.5

18310 PREPARATION OF LARGE CALCIUM-TUNGSTATE CRYSTALS CONTAINING PARAMAGNETIC IONS FOR MASER APPLICATIONS. K.Nassau and L.G.van Uitert.

J. appl. Phys., Vol. 31, No. 8, 1508 (Aug., 1960).

The technique of pulling single crystals from a melt has been applied to calcium tungstate, both pure and containing as impurities cerium, europium, gadolinium, terbium, dysprosium and erbium in concentrations up to 4 formula percent. In this work no flux was used, and crystals up to 7 inches in length and ½ inch in diameter were grown at temperatures near 1600°C. S.A.Ahern

539.2 : 548.5

18311 GERMANIUM CRYSTALS GROWN FROM HOLLOW CYLINDRICAL SEEDS. R.C.Frank and J.E.Thomas, Jr.

J. appl. Phys., Vol. 31, No. 9, 1689-90 (Sept., 1960).

Regular growth contour lines were observed on the surface of Ge single crystals grown inwards from hollow cylindrical seeds. Polycrystalline material had distorted surfaces, individual grains appeared to control the direction of crystal growth. The dislocation density at the centre of a single crystal grown inwards was very high. J.Franks

539.2 : 548.5

18312 GROWTH OF GaAs CRYSTALS IN THE ⟨111⟩ POLAR DIRECTION. P.L.Moody, H.C.Gatos and M.C.Lavine.

J. appl. Phys., Vol. 31, No. 9, 1696-7 (Sept., 1960).

Single crystals of GaAs were consistently obtained with the vertical pulling technique, provided the end of the ⟨111⟩ seed terminated in As atoms. Twinning and large grain formation occurred with seeds terminating with Ga atoms, the dislocation density in a single crystal region grown from such a seed increased with distance from the seed. No effect of ⟨111⟩ crystallographic polarity was observed in horizontally grown GaAs crystals. J.Franks

539.2 :

18313 AN IMPROVED METHOD OF GROWING CdS CRYSTALS FROM THE VAPOR PHASE. P.D.Fo

J. appl. Phys., Vol. 31, No. 10, 1733-4 (Oct., 1960).

The gradual increase in the difference in temperatures of Kanthal heating elements enables CdS crystals to be grown dire on the inside of a silica tube, remote from one another, instead a continuous polycrystalline CdS substrate as happens in most existing methods.

539.2 :

18314 SYNTHETIC AMETHYST QUARTZ. L.I.Tsinober and L.G.Chentsova.

Kristallografiya, Vol. 4, No. 4, 633-5 (July-Aug., 1959). In Rus English translation in: Soviet Physics—Crystallography (New Y Vol. 4, No. 4, 593-5 (April, 1960).

Quartz crystals grown in steel autoclaves from K_2CO_3 tak Fe and acquire a green or brown colour. Irradiation by X-rays polished plates cut parallel to (11$\bar{2}$0) for 30 to 60 min with dose $1.35\text{-}2.7 \times 10^6$ r produces an amethyst colour in the positive fo and a smoky violet hue in the negative crystals. Absorption cu are given. S.Tol

539.2 : 5

18315 PRODUCTION OF ALKALI HALIDE SINGLE CRYST FILAMENTS AND POINTS.

J.McNulty, M.Silver and R.S.Witte.

Rev. sci. Instrum., Vol. 31, No. 8, 904-5 (Aug., 1960).

Controlled dissolution of a KCl crystal in water was achiev by painting one face with Glyptal. Filaments 1 cm long and 10 μ dia., and points with tip radii of 1-5 μ were obtained. J.Fr

539.2 :

18316 A SIMPLE ANALOGUE APPARATUS FOR THE STU OF THE TREATMENT OF AN INGOT BY THE ZON MELTING METHOD. F.Bertein.

J. Phys. Radium, Vol. 19, Suppl. No. 12, 121A-123A (Dec., 1958) In French.

A simple analogue kinematic device for studying the zone refining process or more generally the variation of solute conce tration in an ingot by zone melting during the successive operat

539.2 : 5

18317 APPARATUS FOR THE FLOATING-ZONE REFININ OF GALLIUM ARSENIDE. F.A.Cunnell and R.Wick

J. sci. Instrum., Vol. 37, No. 11, 410-14 (Nov., 1960).

The design and operation of equipment to purify and to grow single crystals of gallium arsenide are described. Features of design include a demountable quartz system, adjustment of the r tive position of the ends of the gallium arsenide rod during oper tion, excellent visibility, a traversable heater system and close control of the arsenic pressure in the tube. The latter feature h reduced the problem of ejection of molten material from the zon

539.2 :

18318 SOME FURTHER OBSERVATIONS ON THE GROWT COPPER WHISKERS FROM CUPROUS IODIDE.

S.S.Brenner.

Acta metallurgica, Vol. 7, No. 7, 519-20 (July, 1959).

The variation with temperature of the growth rate of Cu whiskers grown by hydrogen reduction of CuI was compared wit rate calculated on the assumption that growth rate is proportion rate of arrival of CuI molecules at the tip of the whisker. Below the melting point of CuI, the temperature dependence agreed wit calculation, above the melting point a rapid increase in growth r occurred. Growth occurred at the tip because of catalytic actio due to the presence of permanent growth steps. J.Fr

539.2 :

18319 SOME OBSERVATIONS ON MECHANISMS OF GROW OF METAL WHISKERS. W.J.Allan and W.W.Webb.

Acta metallurgica, Vol. 7, No. 9, 646-8 (Sept., 1959).

Growth of Cu whiskers by hydrogen reduction of molten Cu was observed under a microscope. Growth took place both at th base and at the apex, basal growth was an order of magnitude fa Whisker segments were freed by evolution of gas and became attached to other whiskers, and could then cause systematic alterations in growth direction, helical whiskers were formed b this process. X-ray examination revealed no axial screw dislo in the whiskers, dislocations might climb or glide out of the wh during growth, the whisker length would then depend on the ti dislocation is retained. J.Fr

539.2 : 548.5

20 FURTHER OBSERVATIONS ON THE GROWTH OF SILVER WHISKERS FROM SILVER CHLORIDE.
enner.
etallurgica, Vol. 7, No. 10, 677-8 (Oct., 1959).

was shown that the whiskers from liquid silver chloride ut from their base and not by a vapour phase mechanism. ulation of growth velocity was given. H.E.Schmid

539.2 : 548.5

21 ON THE GROWTH OF GERMANIUM DENDRITES.
R.S.Wagner.
netallurgica, Vol. 8, No. 1, 57-60 (Jan., 1960).

roposes a mechanism for the dendritic growth of Ge from d supercooled melts (Abstr. 5703 of 1955). The presence of in planes in a seed lamella bounded by $\{111\}$ faces is shown d to self-perpetuating grooves in which growth occurs. Supg experimental evidence is described. D.G.Holloway

539.2 : 548.5

22 ON THE NATURE OF WHISKERS.
A.Grohman and J.Krylow.
J. appl. Phys., Vol. 11, No. 10, 477-8 (Oct., 1960).

note on some etch figures obtained on polished sections of Si ers. D.G.Holloway

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23 GROWTH KINKS IN COPPER WHISKERS.
S.Saimoto, V.Griffiths and E.Teghtsoonian.
l. Phys., Vol. 31, No. 9, 1693-4 (Sept., 1960).

ome Cu whiskers grown by hydrogen reduction of $CuCl_2$ con- well defined kinks. Kinked whiskers were generally single als, but twinning at a kink could occur. A helical branch of a er contained crystals of two orientations, one of which per- beyond a kink into the straight portion of the whisker. J.Franks

539.2 : 548.5

24 CRYSTAL GROWTH AND THE FORMATION OF SPIKES IN THE SURFACE OF SUPERCOOLED WATER.
ett.
ciol., Vol. 3, 698-706 (Oct., 1960).

bservations made of ice crystals growing on the surface of cooled water show that they take the form of a composite ure, called surface needles, each of which consists of dendrites ng into the liquid, and of ribs growing in the liquid surface. needle is a single crystal. The precise form of the needle is nined by the orientation of the initial nucleus. If its optic axis r normal to the surface, growth occurs rapidly in two dimen- and covers a much larger proportion of the surface than is ed by the narrow surface needles, so that ice forming this way rs to have its optic axis vertical. Hollow ice spikes observed ls are shown to have been formed by the freezing of water d from beneath the surface at the intersection of two or three e needles, the shape of the spike depending on their orienta-

539.2 : 548.5

325 EPITAXIAL VAPOR GROWTH OF Ge SINGLE CRYSTALS IN A CLOSED-CYCLE PROCESS. J.C.Marinace.
. J. Res. Developm., Vol. 4, No. 3, 248-55 (July, 1960).

he $Ge-I_2$ disproportionation reaction in a sealed tube will it Ge epitaxially upon Ge seeds at a typical rate of 10μ/hr at cal temperature of 400°C. Dislocations are of the same kind and ximate concentrations as observed in ordinary melt-grown Ge. ical purity is comparable to the best melt-grown Ge. The on of donors transferred from the source material to the ited material is nearly unity over a wide range of concentrations, the fraction of acceptors transferred is considerably less than . However, either n-type or p-type Ge can be deposited, and ing two sources within the same tube alternating layers can be ned.

539.2 : 548.5

326 EPITAXIAL GROWTH OF SILICON.
E.S.Wajda, B.W.Kippenhan and W.H.White.
. J. Res. Developm., Vol. 4, No. 3, 288-95 (July, 1960).

The epitaxial growth of thin silicon layers on a silicon substrate een studied, using the reaction $2SiI_2 \rightleftharpoons SiI_4 + Si$ to transport Si a high temperature source zone of silicon iodide to a low erature substrate. The structure and thickness of the deposited depend on a number of variables such as temperature, im- y content and Si vapour concentration. C.H.B.Mee

539.2 : 548.5

18327 IMPURITY INTRODUCTION DURING EPITAXIAL GROWTH OF SILICON. R.Glang and B.W.Kippenhan.
I.B.M. J. Res. Developm., Vol. 4, No. 3, 299-301 (July, 1960).

A slight modification of the method described by Wajda, Kippenhan and White in the preceding abstract allows the controlled introduction of impurities such as B, P, As and Sb into epitaxial layers of Si during the growth process. C.H.B.Mee

539.2 : 548.5

18328 THERMAL ETCHING OF SILVER SURFACES PARALLEL TO $\{110\}$ PLANES.
E.D.Hondros and A.J.W.Moore.
Acta metallurgica, Vol. 7, No. 5, 521-3 (July, 1959).

When silver crystals with surface orientation near $\{110\}$ are heated in air, striations having facets of $\{111\}$ and $\{11\bar{1}\}$ can appear. The waviness of the electropolished surfaces used caused variations in the local surface orientation of about 2° and these variations determine which facets are exposed. H.Mykura

539.2 : 548.5

18329 ON THE THERMAL ETCHING OF SILICON IRON.
C.G.Dunn and J.L.Walter.
Acta metallurgica, Vol. 7, No. 9, 648-50 (Sept., 1959).

Striations are formed on surfaces of high purity silicon iron with surface orientation near (100) and (111) during heating in argon at 1200°C. Small steps are also formed on surfaces near (110). Heating in vacuum also produces striations initially, but they disappear during longer heating in vacuum. The argon used contained some oxygen and the results are explained in terms of the adsorption of oxygen on the surface causing changes in relative surface energy. H.Mykura

539.2 : 548.5

18330 ON THE MECHANISM OF CHEMICALLY ETCHING GERMANIUM AND SILICON. D.R.Turner.
J. Electróchem. Soc., Vol. 107, No. 10, 810-16 (Oct., 1960).

The electrode potential of germanium or silicon in a chemical etching solution is a function of solution pH, rate of etching, physical condition of the surface, conductivity type and resistivity. The results suggest that excess holes and electrons are produced at the surface of the semiconductor during chemical etching. Holes are injected at cathode sites, but only a portion of these holes are consumed at anode sites since the anode reaction involves current multiplication.

539.2 : 548.5

18331 ETCH FIGURES ON TIN AND ZINC.
N.S.Pandya and C.J.Shah.
J. sci. industr. Res., Vol. 18B, No. 2, 85-6 (Feb., 1959).

539.2 : 548.5

18332 ETCH FIGURES ON CLEAVAGE PLANE OF BISMUTH.
N.S.Pandya and V.P.Bhatt.
J. sci. industr. Res., Vol. 19B, No. 9, 363-4 (Sept., 1960).

Single crystals of bismuth (grown from the melt by Bridgmann's method, cleaved along the (111) plane and chemically polished) exhibit at some places characteristic triangular patterns consisting of edges made up of broken triangles. The specimen on subsequent etching in 5 per cent aqueous solution of silver nitrate shows triangular etch pits with random distribution. Rows of closely packed triangular etch pits are also observed which may represent the dislocation sites.

539.2 : 548.7

18333 SUMMARIZED PROCEEDINGS OF A CONFERENCE ON THE BORDERS OF X-RAY ANALYSIS — READING, APRIL, 1960.
Brit. J. appl. Phys., Vol. 11, No. 11, 481-5 (Nov., 1960).

The annual spring conference of the X-ray Analysis Group of The Institute of Physics was held at the University of Reading, on 8 and 9 April, 1960. The papers and discussions ranged over a number of subjects including neutron and electron diffraction, X-ray emission spectroscopy and X-ray micro-analysis.

539.2 : 548.7 : 537.533

18334 INTERNATIONAL SYMPOSIUM ON ELECTRON DIFFRACTION AT THE FEDEROV SESSION, 1959.
Z.G.Pinsker.
Kristallografiya, Vol. 4, No. 5, 801-3 (Sept.-Oct., 1959). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 4, No. 5, 760-4 (May, 1960).

A summary of the contributions made to this symposium, held in Leningrad on 21-27 May 1959 as part of the commemoration of E.S. Federov. The main topics were (a) structure analysis by electron diffraction with the use of kinematic and dynamic scattering, (b) diffraction from gaseous molecules and (c) inelastic scattering and electron diffraction at high voltages. J.Iball

539.2 : 548.7

18335 CHOICE OF COLLIMATORS FOR A CRYSTAL SPECTROMETER FOR NEUTRON DIFFRACTION.

G.Caglioti, A.Paoletti and F.P.Ricci.
Nuclear Instrum., Vol. 3, No. 4, 223-8 (Oct., 1958).

Some criteria are established for the choice of the collimators for a crystal spectrometer for neutron diffraction in order to achieve a good compromise between luminosity and resolution. General expressions for the full width at half maximum and for the luminosity of the diffraction peaks are developed for a powder sample. The advantage of the parallel arrangement is also computed.

539.2 : 548.7

18336 TRANSLATING DEVICE FOR AN X-RAY POWDER CAMERA.

D.A.Northrop.
Rev. sci. Instrum., Vol. 31, No. 10, 1160 (Oct., 1960).

539.2 : 548.7

18337 THE LOW TEMPERATURE METHOD IN ELECTRON DIFFRACTION ANALYSIS.

V.F.Dvoryankin.
Kristallografiya, Vol. 4, No. 3, 441-59 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 415-34 (March, 1960).

Eight low-temperature electron-diffraction specimen holders are described. Calculations are given to show the rate of ice deposition on the specimen from residual water vapour in the column, and specimen heating by the incident beam is discussed. Work on electron diffraction by thin metal films produced by vapour condensation on a cooled support is described and surveyed. The size of crystals, recrystallisation, and phase changes are considered. A special apparatus for studying metal films in the superconducting state is described, and a table given for Hg, Pb, Tl, In, Zn, and Al listing crystal structure, lattice constant, and the ratio of the critical temperature of a thin evaporated specimen to that of a massive specimen. Next, the structure of ice as studied by electron diffraction is surveyed, with diagrams of the proposed structures of both the hexagonal and cubic modifications. Cubic ice: a = 6.37 ± 0.02 A at −190° C. a = 6.36 ± 0.03 A at −130° C. Hexagonal ice: a = 4.50 ± 0.03 A; c = 7.31 ± 0.05 A at −190° C. Two methods of obtaining thin ice films for electron diffraction are given. Finally, various solid-state physics problems are considered: variations of the a/b parameter ratio for polyethylene and the paraffin $C_{29}H_{60}$ are given at temperatures of −195° C., +20° C., and at their transition points. Low temperature electron diffraction photographs of cellulose fibres have been obtained before the fibres were decomposed by the beam. Those of crystalline cellulose of Valonia gave a monoclinic cell with dimensions: a = 8.39; b = 10.58; c = 7.94 A; $\beta = 82^\circ$. At 90° K no superlattice lines could be found in the electron diffraction pattern of orthorhombic KH_2PO_4. At low temperatures the intensities of the diffuse reflections from anthracene are much less than at room temperature. The survey contains 78 references. R.V.Coates

539.2 : 548.7

18338 INFORMATION THEORY AND THE DETERMINATION OF CRYSTAL STRUCTURES.

Ja.Lajzerowicz and Jo.Lajzerowicz.
C.R.Acad. Sci. (Paris), Vol. 251, No. 5, 744-6 (Aug. 1, 1960). In French.

Probability methods in the determination of the phases of the coefficients of Fourier series are applied by making use of the criterion of maximum entropy. A law of "plausible" probability is derived which can give the Patterson function and then by introducing known facts about the structure a function giving the probability of an atom being in a particular position. J.Iball

539.2 : 548.7

18339 A UNIFIED GRAPHICAL METHOD OF INDEXING X-RAY DIFFRACTION PATTERNS OF POLYCRYSTALS. I. ORTHORHOMBIC SYSTEM.

S.L.Nudel'man.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 289-95 (1959). In Russian.

Presents a method of interpretation of X-ray diffraction patterns for the cubic, tetragonal, hexagonal, orthorhombic, monoclinic and triclinic systems. The method is used to interpret the pattern of $BaSO_4$ (an orthorhombic crystal). A.Tybulewicz

539.2 :

18340 A UNIFIED GRAPHICAL METHOD OF INDEXING X DIFFRACTION PATTERNS OF POLYCRYSTALS. I MONOCLINIC AND TRICLINIC SYSTEMS.

S.L.Nudel'man.
Fiz. tverdogo Tela, Sbornik [Supplement] II, 306-16 (1959). In Russian.

The method presented in Pt I is used to interpret the patter a monoclinic crystal (dickite) and a triclinic crystal (kaolinite). A.Tybule

539.2 :

18341 A MAGNETIC RECORDER DOUBLE FOURIER SER SYNTHESIZER USING ONE-DIMENSIONAL SUMMA

R.Chidambaram.
J.sci. industr. Res., Vol. 18B, No. 9, 388-9 (Sept., 1959).

539.2 : 54

18342 SOLUTION OF THE MAIN PROBLEMS OF STRUCT ANALYSIS ON UNIVERSAL COMPUTERS.

N.P.Trifonov and B.M.Shchedrin.
Kristallografiya, Vol. 4, No. 3, 315-23 (May-June, 1959). In Russian. English translation in: Soviet Physics—Crystallograph (New York), Vol. 4, No. 3, 293-9 (March, 1960).

An account of the crystallographic computing programmes are available for the "Strela" digital computer at the Computing Centre of Moscow State University. Only two-dimensional progra have been used so far but three-dimensional ones are being wri One set of programmes is for centro-symmetric plane groups a another set for the groups without a centre of symmetry. The programmes are (a) Fourier synthesis using F or F^2 (b) structu factor calculations (c) refinement of atomic parameters by diffe tial synthesis. The programmes will deal with up to 1542 obser structure factors and up to 95 atoms in the asymmetric unit with a maximum of 24 types and not more than 63 atoms of any one typ J.I

539.2 : 54

18343 SECOND-ORDER PHASE TRANSITIONS IN CRYSTA OF SYMMETRY T_h^6.

G.Ya.Lyubarskii and O.V.Kova
Kristallografiya, Vol. 4, No. 1, 121 (Jan.-Feb., 1959). In Russian English translation in: Soviet Physics—Crystallography (New Yo Vol. 4, No. 1, 111 (Jan., 1960).

A note giving the space groups to which a crystal, originally possessing the symmetry of T_h^6, may belong after a second-orde phase transition. Examples of such crystals are FeS_2, $CoSe_2$, $Pb(NO_3)_2$. The argument is based on Landau's theory of these transitions (see Abstr. 3187 of 1937). J.Iba

539.2 : 54

18344 AN INVESTIGATION OF Fe_3O_4 BY ELECTRON DIFFRACTION.

G.G.Dvoryankina and Z.G.Pinsker.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 1, 110-13 (May 1, 1960). In Russian.

Polycrystalline layers, prepared by the oxidation of evapora iron films on rocksalt at 300-350° C, showed a lattice parameter a = 8.40 ± 0.01 A. An analysis of the intensities of a large numb of diffraction lines confirmed an inverse spinel structure and ena a u parameter of 0.258 ± 0.002 to be derived, compared with u = 0.375 for the ideal spinel structure. The distances for oxyge tetrahedral site and oxygen—octahedral site were 1.935 and 2.03 in good agreement with sums of the appropriate ionic radii. Pote tial peak heights for atomic sites were: oxygen 422 V, octahedral Fe 1062 V, and tetrahedral Fe 1120 V. C.H.L.Goodm

539.2 : 54

18345 STUDIES ON MOLYBDENUM OXIDES.

L.Kihlborg.
Acta chem. Scand., Vol. 13, No. 5, 954-62 (1959).

The MoO_2—MoO_3 region of the molybdenum—oxygen system investigated within the temperature range 500°-870° C, by means X-ray diffraction techniques. Temperature regions are given for the formation of the seven intermediate phases found, among whi are two previously undescribed oxides designated θ- and κ-oxides Unit-cell dimensions and X-ray diffraction data are given and formulae are suggested for the ζ-oxide (Mo_9O_{26}, triclinic), the κ-oxide ($Mo_{17}O_{47}$, orthorhombic) and the η-oxide (Mo_4O_{11}, monocl The unit cell dimensions were also determined for the θ-oxide ($MoO_{\sim 2.80}$, tetragonal), which is probably metastable. The electr resistivity at room temperature was determined for the various intermediate phases excluding the θ-phase. The oxidation of the

in air at 230°-350° C was studied. An intermediate stage,
-oxide, was observed in the oxidation of the two Mo_4O_{11}
to MoO_3.

539.2 : 548.7

46 AN X-RAY INVESTIGATION OF THE NICKEL—BORON SYSTEM. THE CRYSTAL STRUCTURES OF ORTHO-
BIC AND MONOCLINIC Ni_4B_3. S.Rundqvist.
hem. Scand., Vol. 13, No. 6, 1193-208 (1959).
he Ni—B system was investigated with X-ray powder and
-crystal methods in the range Ni_3B—NiB. In addition to the
usly known intermediate phases, Ni_3B, Ni_2B and NiB, the
nce of two other phases, both with the ideal compositions Ni_4B_3
e orthorhombic and the other monoclinic, was established.
llowing two-phase regions have been found: $Ni_3B + Ni_2B$,
orthorhombic Ni_4B_3, orthorhombic Ni_4B_3 + monoclinic Ni_4B_3
onoclinic Ni_4B_3 + NiB. The unit cell of orthorhombic Ni_4B_3
slightly with composition: the dimensions in two-phase Ni_2B +
rhombic Ni_4B_3 alloys are the following: a = 11.953 A,
81 A, c = 6.569 A and in two-phase orthorhombic Ni_4B_3 + mono-
Ni_4B_3 alloys: a = 11.973 A, b = 2.985 A, c = 6.584 A. The unit
mensions of monoclinic Ni_4B_3 are a = 6.430 A, b = 4.882 A,
18 A, β = 103°18' No unit cell variation of the latter phase
und. The crystal structures of the two new phases were deter-
and refined from single-crystal intensity data. The space
of orthorhombic Ni_4B_3 is Pnma; the unit cell contains 16 nickel
and 12 boron atoms situated in 4(c) positions. Two-thirds of
ron atoms form infinite zig-zag chains, while one-third have
se boron contacts. There are probably boron vacancies in the
ure. The space group of monoclinic Ni_4B_3 is C 2/c. Sixteen
atoms are situated in two 8(f) positions, 8 boron atoms in one
sition and 4 boron atoms in one 4(e) position. All boron atoms
nnected in infinite chains.

539.2 : 548.7

47 THE CRYSTAL STRUCTURE OF $Ni_{12}P_5$.
S.Rundqvist and E.Larsson.
hem. Scand., Vol. 13, No. 3, 551 [illegible] (1959).
he structure was determined by single-crystal methods. The
ll containing 2 formula units, is tetragonal, a = 8.646 A;
70 A. The space group is I4/m - (C_{4h}^5) with 16 Ni in 16(i):
116_0; y = 0.182_2; z = 0.248; 8 Ni in 8(h): x = 0.368; y = 0.060;
8(h): x = 0.195; y = 0.415; and 2 P in 2(a). A comparison of
with related structures is made. Some phase-analytical ob-
ions in the Ni—P system are reported. NiP_3 is cubic,
319 A; and isostructural with CoP_3, a = 7.706 A. Both NiP_3 and
elong to the D2 ($CoAs_3$) structure type.

539.2 : 548.7

48 LATTICE PARAMETERS OF SOLID SOLUTIONS OF PHOSPHORUS IN IRON. B.Gale.
metallurgica, Vol. 7, No. 6, 420-1 (June, 1959).
he lattice parameter a of pure Fe is 2.86654 A. X-ray
ction measurements showed that a decreased with increasing
tent to 2.865 A with 1.6 at.% P, indicating that P forms a
tutional solid solution. The solubility limit appeared to be
1.6 at.% P at 950°C. J.Franks

539.2 : 548.7

49 THE CRYSTAL STRUCTURE OF Ru_7B_3.
B.Aronsson.
hem. Scand., Vol. 13, No. 1, 109-14 (1959).
he structure was determined from single crystal data. There
o formula units in the unit cell, which Åselius has determined
hexagonal with a = 7.467 A and c = 4.713 A. The space group
mc. The ruthenium atoms are situated in two six-fold posi-
6 (c) with x_I = 0.4563, z_I = 0.318, and x_{II} = 0.1219, z_{II} = 0.000
e two-fold position 2(b) with z_{III} = 0.818. The structure of
is very closely related to that of the trigonal chromium car-
r_7C_3.

539.2 : 548.7

50 EXPERIMENTAL VALUES FOR STRUCTURE AMPLITUDES OF SODIUM CHLORIDE MEASURED BY
WDER METHOD. S.Vihinen.
cad. Sci. Fennicae A VI, No. 52, 33 pp. (1960).
n automatically recording X-ray diffractometer with photo-
plier tube as detector, previously described (Abstr. 1936 of
, was used for determining the relative integrated intensities
rays diffracted from sodium chloride at a temperature of 26°C.
pecimens were in the form of plates of fine crystalline powder. Cu Kα and Mo Kα filtered radiations were employed, and the last reflection measured was (12 0 0), corresponding to the value 1.06 A^{-1} of (sin θ)/λ. Structure amplitudes (structure factors) were calculated from the integrated intensity values measured. Different factors affecting the accuracy of the results were discussed. Comparison of the results with the theoretical values given by Freeman (Abstr. 5100 of 1959) reveals very good agreement. The values obtained by the author differ but slightly from the relatively recent experimental values obtained by Renninger, and Witte and Wölfel, and rather more from the values of Schokneckt, all of whom used single crystals in their investigations. The principal aim in performing the measurements was to reduce the errors of strong and medium strong reflections, because in calculations involving the experimental values of structure amplitudes, a higher percentage accuracy is, in general, needed for these reflections in order to reduce the absolute error sufficiently. The result was that the standard deviations of the structure amplitude values were, even for strong reflections, of the order of 0.05 unit of the atomic structure factor, which is considerably less than those obtained by other recent investigators. Detailed considerations showed that the possible systematic errors are probably of the same order of magnitude. Application of the results to calculations of the atomic structure factors of Cl^- and Na^+ in different crystallographic directions is in progress.

539.2 : 548.7

18351 ON THE DETERMINATION OF THE ELECTRON DENSITY IN ATOMS OF SODIUM CHLORIDE ACCORDING TO THE FOURIER INTEGRAL METHOD.
V.Hovi and Y.Pautamo.
Ann. Acad. Sci. Fennicae A VI, No. 53, 8 pp. (1960).

Extrapolation and interpolation of certain experimental crystal structure factors have been examined. Their influence on the electron density distribution in the ions of NaCl was investigated. For the calculations the experimental data of Schoknecht (Abstr. 6375 of 1959) and of Witte and Wölfel (1958) were used. Two of the four extrapolation functions were determined by means of the method of least squares. The electron density distributions were calculated by using the Fourier integral method. The comparison between the electron density curves shows that even slight variations in the extrapolation curves can cause quite considerable variations in the electron density curves. The results obtained in the present investigation do not give any proof of the reality of the deformation of the electron clouds in the ions of NaCl.

539.2 : 548.7

18352 ORDERING IN THE INTERMEDIATE PHASES TiFe, TiCo, AND TiNi. P.Pietrokowsky and F.G.Youngkin.
J. appl. Phys., Vol. 31, No. 10, 1763 - 6 (Oct., 1960).

The intermediate phases TiFe, TiCo, and TiNi have been investigated by X-ray powder diffraction techniques. The atomic arrangements of these ensembles have been determined to be of the caesium chloride, B2 type. Monochromatic X-radiation was utilized in the investigation.

539.2 : 548.7

18353 STRUCTURAL CHARACTERISTICS OF VANADIUM OXIDE. P.V.Gel'd, S.I.Alyamovskii and I.I.Matveenko.
Fiz. Metallov. i Metallovedenie, Vol. 9, No. 2, 315-17 (Feb., 1960).
In Russian.

The samples, prepared by sintering and varying in composition from $VO_{0.75}$ to $VO_{1.74}$, were heated at 1400° C for 60-76 hr. X-ray structure analyses were then made, the results of which are tabulated. $VO_{0.75}$ and $VO_{1.3}$ were found to be two-phased. In the composition range $VO_{0.85}$-$VO_{1.25}$, a relation existed between the lattice parameter and the composition. The possible existence of a ζ-phase, and the vacancy concentration are considered. The concentration dependence of the thermo e.m.f. was also investigated.

539.2 : 548.7

18354 X-RAY STUDIES OF CRYSTALLIZATION IN SORBED WATER. V.S.Brzhan.
Kristallografiya, Vol. 4, No. 4, 631-3 (July-Aug., 1959). In Russian.
English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 4, 590-2 (April, 1960).

Two different anomalous forms of ice occur in water sorbed on silica gel, with 104A pores and with pores larger than 1000 A. Both have only the lines of hexagonal ice, with unusual ratios between the intensities. The patterns show little variation over the range from −10 to −170° C. C.Turner

539.2 : 548.7

18355 TWENTY-ONE NEW X-RAY DIFFRACTION POWDER PATTERNS.

H.G.Norment, P.I.Henderson and R.L.South.
Analyt. Chem., Vol. 32, No. 7, 796-9 (June, 1960).

A collection of 21 standard X-ray diffraction powder patterns, mostly of boron compounds, is presented. The data have been collected by both diffractometer and Debye—Scherrer methods.

539.2 : 548.7

18356 CRYSTAL STRUCTURE OF $BaGa_2O_4$ AND $BaAl_2O_4$.

R.Hoppe and B.Schepers.
Naturwissenschaften, Vol. 47, No. 16, 376 (1960). In German.

$BaGa_2O_4$ is hexagonal, with a = 10.74 A, c = 8.67 A, Z = 8 formula-units per cell: the cell is thus doubled in the a-direction as compared with $BaAl_2O_4$. A.R.Stokes

539.2 : 548.7

18357 POWDER DATA, UNIT CELL AND SPACE GROUP FOR FERROUS SULPHATE.

C.W.F.T.Pistorius.
Indian J. Phys., Vol. 33, No. 8, 363-6 (Aug., 1959).

Anhydrous ferrous sulphate crystallizes in the orthorhombic system. The dimensions of the unit cell are $a_0 = 5.261$ A, $b_0 = 8.013$ A, $c_0 = 6.454$ A. The most probable space group is D^{17}_{2h}-Cmcm. The unit cell contains $(FeSO_4)_4$.

539.2 : 548.7

18358 X-RAY POWDER DIFFRACTION STUDIES OF HAFNIUM TETRAIODIDE.

B.Krause, A.B.Hook, F.Wawner and H.Rosenwasser.
Analyt. Chem., Vol. 32, No. 9, 1210-11 (Aug., 1960).

Hafnium tetraiodide, HfI_4, was prepared by direct combination of the elements, and was yellow-orange in colour. Powder diffraction photographs were taken on an 11.46 cm diameter Philips camera using nickel filtered Cu Kα radiation. A table is given of the d-values, observed relative intensities, proposed indices, and calculated lattice constants. The pattern seems to be produced by a f.c.c. lattice of parameter 5.88 A, but a cell twice as large is assumed by analogy with the tetrahalides $TiBr_4$ and SiI_4. It is assumed that HfI_4 belongs to the T_h^6 - Pa3 space group, with eight molecules per unit cell. R.V.Coates

539.2 : 548.7

18359 X-RAY INVESTIGATIONS ON Me—Si—B SYSTEMS (Me =Mn, Fe, Co). I. SOME FEATURES OF THE Co—Si—B SYSTEM AT 1000° C. INTERMEDIATE PHASES IN THE Co—Si—B AND Fe—Si—B SYSTEMS.

B.Aronsson and G.Lundgren.
Acta chem. Scand., Vol. 13, No. 3, 433-41 (1959).

Some features of the Co—Si—B system at 1000° C were determined with X-ray methods. It was found that the homogeneity ranges of the intermediate phases are small. The crystal structure of the ternary phase $Co_{4.7}Si_2B$ (isomorphous with $Fe_{\sim 4.7}Si_2B$) was established from single crystal data and is closely related to the W_5Si_3(T1) structure. The Fe—Si—B system contain several ternary phases, the most remarkable of which is a cementite (Fe_3C) type phase, while the crystal structures of Fe_5SiB_2 and Mn_5SiB_2 are shown to be of the Cr_5B_3(T2) type.

539.2 : 548.7

18360 THE STRUCTURES OF Ni_6Si_2B, Fe_2P AND SOME RELATED PHASES.

S.Rundqvist and F.Jellinek.
Acta chem. Scand., Vol. 13, No. 3, 425-32 (1959).

It has been found that the Fe_2P (C 22) structure previously proposed must be revised. The true symmetry is hexagonal, rather than trigonal. The phases Ni_6Si_2B, Mn_2P, and Ni_2P are isotypic with Fe_2P, but Co_2P possesses a different — orthorhombic — structure. Some structurally related phases are also discussed.

539.2 : 548.7

18361 X-RAY MEASUREMENTS OF THE THERMAL EXPANSION OF $KLiSO_4$ AND $K_3Na(SO_4)_2$ (LOW AND HIGH TEMPERATURE MODIFICATIONS).

H.F.Fischmeister and A.Rönnquist.
Ark. Kemi, Vol. 15, Paper 35, 393-6 (1960).

The variations of the cell constants as a function of temperature between room temperature and the melting point are shown graphically and the values of the cell constants at room temperature and at the transition and melting points are listed for both substances. The expansion of $KLiSO_4$ is linear and the change in the cell constants at the transition temperature, 435° C, indicates a volume increase of about 1%. The transition in $K_3Na(SO_4)_2$ at 447° C is discontinuous with a volume increase of about 4%. S.Weintroub

539.2 : 5

18362 THE PROBLEM OF THE POSITION OF THE POTASSIUM ION IN MICA STRUCTURE.

L.S.Zevin and M.S.Leizerzon.
Kristallografiya, Vol. 4, No. 3, 422-3 (May-June, 1959). In Russ
English translation in: Soviet Physics—Crystallography (New York), Vol. 4, No. 3, 395-6 (March, 1960).

The structure of phlogopite consists of a three-layer stack in which two layers of silica tetrahedra are separated by a laye magnesia (or in mica by a layer of alumina). The potassium ion both mica and phlogopite is assumed to be between successive st in the crystal. Electron density projections on the z-axis (perpendicular to the stacks) were obtained with Cu Kα radiation for three specimens of phlogopite. These were compared with calculated electronic density projections assuming (a) the K ions are arranged symmetrically between the stacks, or (b) the K ion intrude into the upper and lower stacks until they touch an oxyge ion. The results show that (a) is the correct assumption [see Gatineau and Mering, C.R. Acad. Sci. (Paris), Vol. 246, No. 6, 9 (1958)]. J.

539.2 : 5

18363 A NEW DETERMINATION OF THE CRYSTAL STRUCTURE OF LEONITE $K_2Mg(SO_4)_2.4H_2O$.

W.Schneider.
Naturwissenschaften, Vol. 47, No. 12, 277-8 (1960). In German.

539.2 : 5

18364 THE CRYSTAL STRUCTURES OF THE COMPOUND $(SnSe)_{1-x-y}(SnTe)_x(PbTe)_y$.

A.Nishiyama and T.Okad
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 3, No. 1, 3-7 (March, 1960)

The crystal structures of the compounds $(SnSe)_{1-x-y}(SnTe)_x(PbTe)_y$ were examined by X-ray diffraction using powdered specimens. A classification into the following three regions is n the NaCl type (B1 type) structure, the SnS type (B29 type) structu and the region consisting of the two phases. The lattice constant the first region vary almost linearly with the composition.

539.2 : 5

18365 THE LATTICE PARAMETERS OF CHRYSOTILE.

S.L.Nudel'man.
Kristallografiya, Vol. 4, No. 4, 621-3 (July-Aug., 1959). In Russ
English translation in: Soviet Physics—Crystallography (New Yo
Vol. 4, No. 4, 581-3 (April, 1960).

The system described in earlier papers (Abstr. 8568 of 195 Pribory i Tekh. Eksper, 1952, No. 2) for derivation of cell parameters for orthorhombic crystals from powder patterns, is exte to monoclinic crystals. As an example, the parameters of chrys are worked out. C.Tur

539.2 : 5

18366 PRELIMINARY REPORT ON THE CRYSTAL STRUCTURE OF ANTHRONE.

S.N.Srivastava.
Indian J. Phys., Vol. 33, No. 10, 456-8 (Oct., 1959).

Two-dimensional Fourier synthesis in the 010 plane is used. Revised lattice parameters are given. A table of interatomic distances from an origin at the centre of symmetry is given assu ing the molecule to be planar. G.F.J.Gar

539.2 : 5

18367 SPACE GROUP OF CYCLOHEXANONE AT −180° C.

G.S.R.Krishna Murti.
Indian J. Phys., Vol. 33, No. 9, 401-4 (Sept., 1959).

The Debye—Scherrer pattern of frozen cyclohexanone at −18 has been photographed and analysed. It has been found that the crystal is orthorhombic with the unit cell dimensions a = 10.38 A b = 7.34 A and c = 15.09 A. The density of cyclohexanone at −18 has been measured and it has been found that there are 8 asymm molecules in the unit cell. The space group Q_h^1 is assigned to th crystal.

539.2 : 5

18368 THE THERMAL EXPANSION OF THE CRYSTALLIN B- AND C-FORMS OF STEARIC ACID.

G.Degerman and E.von Sydow.
Acta chem. Scand., Vol. 13, No. 5, 984-8 (1959).

The changes with temperature of the cell dimensions and the density of the B- and C-forms of stearic acid have been determi The influence on the c-axis is very slight. The effect on the sub axes is similar to the disturbing effect of branching groups, i.e. a_s-axis, ~ 4.95 A, is almost unchanged but the b_s-axis, ~ 7.40 A appreciably increased.

539.2 : 548.7

369 AN X-RAY INVESTIGATION OF THE BINARY SYSTEM STEARIC ACID—PALMITIC ACID.

erman and E.von Sydow.

hem. Scand., Vol. 13, No. 6, 1176-82 (1959).

he molecular arrangement for the 1 : 1 compound between c (S) and palmitic (P) acid was determined. The structure is p of S—P pairs. Its unit cell is very like those of the com- s, but the symmetry is lower: P 2_1 instead of P 2_1/a. To get ered 1 : 1 phases, which are of technical importance, the r of solid ⇌ liquid transitions should be limited, the lowest le temperatures should be used and solidification accomp- as rapidly as possible.

539.2 : 548.7

370 SPACE GROUP OF 1, 3, 5-TRICHLOROBENZENE.

S.G.Biswas.

J. Phys., Vol. 33, No. 9, 371-5 (Sept., 1959).

ebye—Scherrer patterns of pure 1, 3, 5-trichlorobenzene at as well as at −180° C have been photographed and analysed. sis of the patterns shows that the crystals of the substance to orthorhombic system with a = 14.15 A, b = 9.90 A, c = 6.32 A −180° C only a very small amount of contraction takes place. ectron diffraction pattern of a microcrystal resembling that a fibre has also been photographed with the fibre axis along axis of the crystal. The unit cell dimensions mentioned above explain all the reflections in the electron diffraction pattern. dering the dimensions of the unit cell and the approximate y of the crystal the number of molecules in the unit cell was to be four, the accurate value of the density being 1.34 gm cm^{-3}. pace group D^1_2 has been assigned to the crystal.

539.2 : 548.7

371 EFFECT OF A SECOND CRYSTALLINE MODIFICATION IN POLYETHYLENE ON X-RAY CRYSTALLINITY SUREMENTS.

C.G.Vonk.

a (London), Vol. 186, 962-3 (June 18, 1960).

Polyethylene which has undergone severe mechanical treat- can exist in a second crystalline modification in addition to ormal rhombic one. Slichter (Journal of Polymer Science, 21, 141, 1956) suggested that the second modification also s in undeformed polyethylene. This latter suggestion could in certain anomalies in the results of density and crystalli- neasurements which are described in the paper. J.Iball

VARIOUS SOLID STRUCTURES

539.21

372 DIRECT MEASUREMENT OF THE TRANSITION ENERGY OF $CsNO_3$ AT 153.8°C.

vi, A.Arell and M.Varteva.

Acad. Sci. Fennicae A VI, No. 39, 7 pp. (1960).

The transition energy of $CsNO_3$ at 153.8°C has been measured tly by means of a cooling precision differential calorimetric od. The result obtained was in good agreement with that deter- d previously by Mustajoki (Abstr. 3957 of 1958) by means of an ect method. It is shown that the direct method gives a some- greater value for the transition energy that the indirect ones. advantages of the present method are discussed.

539.21

8373 ISOTHERMAL REVERSION OF THE B.C.C. → H.C.P. TRANSFORMATION INDUCED IN β' AgCd BY HANICAL DEFORMATION.

D.B.Masson.

metallurgica, Vol. 8, No. 2, 71-80 (Feb., 1960).

The hexagonal close-packed structure induced in β' AgCd by anical deformation was found to revert gradually to the original -centered cubic structure at room temperature. The rate of rsion was measured for several alloys of composition around .%. The reversion rate was found to be dependent on composi- and temperature; the process appeared to be thermally activated an activation energy of about 23 kcal/mole. The rate data were to agree with equations that have been derived by other authors ucleation and growth processes.

539.21

18374 THE COBALT TRANSFORMATION.

C.R.Houska, B.L.Averbach and M.Cohen.

Acta metallurgica, Vol. 8, No. 2, 81-7 (Feb., 1960).

The f.c.c. ⇌ h.c.p. transformation in cobalt powder (equilibrium temperature = 417° C) has been studied by X-ray methods and correlated with the density of stacking faults in both phases. Only the h.c.p. phase is present in the cold-worked powder. The line broadening due to local strains and small particle sizes can be essentially removed by annealing at 300° C, leaving a residual broadening that permits a quantitative determination of the density of random growth and deformation faults. The latter are present in smaller numbers than the growth faults, and are more readily removed by recovery treatments. When the h.c.p. phase is generated from the f.c.c. phase by cooling through the allotropic transformation range, two types of faulted regions become evident: region 1 contains only deformation faults, and region 2 contains both deformation and growth faults. It is suggested that region 1 constitutes the first part of the h.c.p. phase to form on cooling, while region 2 represents the latter part of the transformation. Approximately 25-30% of the parent f.c.c. phase is retained at room temperature under these conditions. Faulting in the f.c.c. phase can be detected with some assurance only after the cooling transformation is underway, but the extent of such faulting is small compared to that in the h.c.p. phase. The observed faulting in both phases is produced mainly by the allotropic transformation, and is not inheritied from the parent phase. The faulting generated in the parent phase by the cooling transformation can be partly removed by holding at subcritical temperatures; it is though that this relaxation process removes barriers to the f.c.c. → h.c.p. transformation and is responsible for the small increments of the h.c.p. phase which form isothermally in the same temperature range. An analysis of the broadening effects in the various diffraction lines suggest that the stacking faults do not terminate within the crystallites of subgrains, but extend to the boundaries. No evidence is found to signify any reversible extension or contraction of the faulting with changing temperature; that is, the faults observed are not in thermodynamic balance

539.21

18375 PHASE TRANSITION IN TUNGSTEN TRIOXIDE.

S.Tanisaki.

J. Phys. Soc. Japan, Vol. 14, No. 5, 680-1 (May, 1959).

X-ray investigation has shown that this material has a monoclinic structure at room temperature in which ions are arranged in an antiparallel manner, and it transforms to an orthorhombic phase near 350° C on heating and transforms near −40° C on cooling to a lower temperature form which has been supposed to be trigonal. In the present note the phase transition from monoclinic to triclinic near 17° C is described. The tabular crystal of WO_3 with c-surfaces well developed has usually two kinds of domains whose walls are (110) and (100) at room temperature, but sometimes another kind of domain formed by twinning on (010) plane is found below 17° C. This (010) domain structure can be easily observed with the polarizing microscope between crossed nicols, because, when the c-surface of the crystal is observed, the extinction position of each domain differs from those of its adjacent domains by about 6°. And also the difference of the extinction positions of neighbouring domains is observed on the a-surface of the crystal. These facts suggest that the crystal with (010) domains may have a triclinic structure, and this suggestion is ascertained by the X-ray method. The lattice constants of the triclinic phase determined from X-ray rotational photographs are:

$a = 7.30$ A, $b = 7.52$ A, $c = 7.69$ A
$\alpha = 88^\circ 50'$, $\beta = 90^\circ 55'$, $\gamma = 90^\circ 56'$.

The triclinic crystal transforms to the monoclinic phase near 17° C on heating and has few or no (100) walls. The transition from the triclinic phase to the lower temperature phase is observed near −40° C on cooling. These two phase transitions can be repeatedly observed with the polarizing microscope, showing a thermal hysteresis to some extent. However, if a crystal slowing the monoclinic-triclinic transition is heated once above 350° C, the monoclinic-orthorhombic transition temperature, it has many fine (100) domains at room temperature and does not show the monoclinic-triclinic transition near 17° C. It seems to be due to this effect of (100) domains that the existence of the triclinic phase between the monoclinic phase and the lower temperature phase has been previously overlooked.

539.21

18376 $\gamma \rightarrow \alpha$ TRANSITION IN Fe_2O_3 WITH PRESSURE.

I.Kushiro.

J. Geomagn. Geoelect., Vol. 11, No. 4, 148-51 (1960).

The temperature of transition of synthetic γ-Fe_2O_3 (maghemite) to α-Fe_2O_3 (hematite) is lowered by increasing pressure. The transition line is represented by the equation, $p = 150-0.3T$, where p is the pressure in bars and T is the temperature in deg C. The transition of Ti-bearing γ-Fe_2O_3 (titanomaghemite) needs higher pressure and temperature than that of pure γ-Fe_2O_3. From the experimental results, it is suggested that maghemite is formed only near the surface of the earth, probably at depths shallower than about 500 m.

539.21

18377 THE TRANSFORMATION TEMPERATURES OF HIGH-PURITY URANIUM.

B.Blumenthal.

J. nuclear Mater., Vol. 2, No. 1, 23-30 (March, 1960).

The transformation temperatures of high-purity uranium were determined by repeated thermal analyses where the rates of heating and cooling were independently controlled. The solid state transformation temperatures and the logarithm of the heating or cooling rates are related linearly. The extrapolated functions intersect at a point where the disturbing effects of hysteresis, superheating and undercooling disappear, i.e. at the equilibrium temperature. The transformation temperatures are $667.7 \pm 1.3^\circ$C for $\alpha \rightleftharpoons \beta$ and $774.8 \pm 1.6^\circ$C for $\beta \rightleftharpoons \gamma$. The mean temperature for melting and freezing is $1132.3 \pm 0.8^\circ$C.

539.21

18378 THE URANIUM–MOLYBDENUM EQUILIBRIUM DIAGRAM BELOW 900°C.

A.E.Dwight.

J. nuclear Mater., Vol. 2, No. 1, 81-7 (March, 1960).

The U–Mo equilibrium diagram has been determined up to 19 wt% Mo and below 900°C. The eutectoid transformation $\beta \rightleftharpoons \alpha + \gamma$ has been located at $639 \pm 5^\circ$C. The limit of the $\beta + \gamma$ field has been placed at 4.5 wt% Mo at the eutectoid temperature. The γ phase undergoes a eutectoid transformation at 10.5 wt% Mo and $565 \pm 5^\circ$C, to $\alpha + \delta$. The tetragonal structure of the δ phase was confirmed, with $c_0 = 9.854$ A, $a_0 = 3.427$ A, $c/a = 2.876$. It is probable that phase is formed by a congruent transformation, rather than by a peritectoid as reported by earlier workers.

539.21 : 536.48

18379 BISMUTH AT LOW TEMPERATURE.

C.S.Barrett.

Acta metallurgica, Vol. 7, No. 12, 810-11 (Dec., 1959).

Describes experiments to check on a reported strain-induced low temperature phase transformation in Bi (Abstr. 3170 of 1960). X-ray diffraction measurements of zone-refined Bi showed no transformation on cooling to 78°K and 4.2°K, nor on plastic deformation at these temperatures. A check on possible superconductivity of work-hardened Bi also gave negative results. H.Mykura

539.213

18380 RELATION BETWEEN THE STRUCTURE AND PHYSICAL PROPERTIES OF GLASSES. I.

I.Naray-Szabó.

Acta phys. Hungar., Vol. 8, No. 1-2, 37-64 (1957). In German.

A short critical review is made of expressions given in the literature for the density of glass. The absolute volume v of the O^{2-} ion, which is easily calculated, is used in the present paper and results of the study of several hundred glasses are presented. Linear relations are found connecting v with R where $R = O/(Si + B + Be + Al + P)$, the symbols denoting the number of gram-atoms of the corresponding elements present. The relations are: $v = (3.8R + 15.3)$ for SiO_2–B_2O_3 glasses; $v = (3.8R + 14.9)$ for sodium silicate glasses; $v = (12R - 1.2)$ for potassium silicate glasses. Similar equations hold for CaO–SiO_2 and SrO–SiO_2 glasses For three-component glasses v is altered from its value in the two-component case with the same R, linearly with the number of gram-atoms of the added component. The observed facts are explained by suggesting that v becomes smaller the more the individual tetrahedra of the network combine together with O^{2-} ions in common.

R.G.C.Arridge

539.213

18381 RELATION BETWEEN THE STRUCTURE AND PHYSICAL PROPERTIES OF GLASSES. II.

I. Náray-Szabó.

Acta phys. Hungar., Vol. 9, No. 1-2, 151-61 (1958). In German.

Continuing the statement of relationships set out in Pt I, equations for the oxygen ion volumes in glasses with four or more ponents are given. The basic equations remain the same as in for sodium silicate and potassium silicate glasses, being modi by the extra components in a similar way to that described for component glasses. The equations can be summarized into fou groups, relating to glasses with the following bases: (a) sodiu silicate; (b) potassium silicate; (c) sodium borosilicate; (d) p ium borosilicate. With these equations one can calculate with accuracy both the oxygen ion volume and the density of glasses whose composition lies between known limits. R.G.C.A

5

18382 THE THEORY OF HARDENING OF GLASS AND IT COMPARISON WITH EXPERIMENT.

V.L.Indenbo

Fiz. tverdogo Tela, Sbornik [Supplement] I, 236-40 (1959). In Russian.

The author refutes Bartenev and Kolbasnikova's criticism (Zh. tekh. Fiz., Vol. 28, 1195, 1958) of his and Kitaigorodskii's theory (Zh. tekh. Fiz., Vol. 24, 925, 1954 and Dokl. Akad. Nauk SSSR, Vol. 108, 843, 1956) by an appeal to experiment and by p ing out errors in Bartenev and Kolbasnikova's empirical form

A.Tybul

5

18383 VISCOSITY AND DENSITY OF MOLTEN SILICA A HIGH SILICA CONTENT GLASSES.

J.F.Bacon, A.A.Hasapis and J.W.Wholley, Jr.

Phys. Chem. Glasses, Vol. 1, No. 3, 90-8 (June, 1960).

The viscosity of fused silica was measured in the tempera range from 1935° to 2322°C. The viscosity varied from $\log_{10}$ 5 4.63 (viscosity in poises). The counterbalanced sphere method similar to that employed by Shartsis and Spinner [J. Res. Nat. Stand., Vol. 46, No. 2190 (1951)] was adopted. The viscosity of fused silica with about 1% by weight cobalt oxide was determin from 2090 to 2350°C and found to be lower by a factor of appro mately 3.5. In both cases, the silica used was Amersil fused q with a total impurity content of approximately 0.01% by weight. ther studies were made, using the same method, with Corning Works 7900 Vycor and 7740 Pyrex. The viscosity of Vycor va from $\log_{10}$ 4.59 to 4.00 in the temperature range of 2091 to 218 Pyrex varied from $\log_{10}$ 5.06 to 3.34 from 1046 to 1389°C. The viscosity of Corning Glass Works 7740 Pyrex had been measur previously by Corning with the rotating cup viscometer and the results of the two methods agreed to within 0.5% in $\log_{10}$ viscos

5

18384 THE HEAT CAPACITY OF LINEAR POLYMERS A TEMPERATURES.

I.V.Sochava.

Dokl. Akad. Nauk SSSR, Vol. 130, No. 1, 126-8 (Jan. 1, 1960). In Russian.

Polymers without side chains were chosen for comparison theory. Polyethylene was measured between 17 and 60°K, trifl ethylene between 23 and 120°. Smoothed values are tabulated a shown as log c_p versus log T. For polyethylene the slope, m, f from 2.15 to 1.1. A value of $m > 1$ indicates the influence of i action between the chains. For trifluorethylene m is 1.3 at 23° 1 at 30°K, and is at its lowest, 0.65-0.70 at 35°, then rises to 0 the range from 60 to 120°K. The different behaviour of the tw polymers is ascribed to the different masses of the CF_2 and C groups, compared with CH_2. Rocking modes of the two heavier may be responsible for the change in trifluorethylene at 60°.

R.Be

539.217 :

18385 THE PRODUCTION OF EXTREMELY FINE-PORE SILVER MEMBRANES.

F.I.Havliček.

"J. Stefan" Inst. Rep., Vol. 3, 135-40 (Oct., 1956). In German.

Membranes with mechanical properties suitable for mount etc., and of porosity (10^{-6} cm) suitable for the separation of ga isotopes are readily prepared by dissolving out the zinc from f of Ag–Zn alloy (33% Zn). Experiments are described on the e ment of the heavy hydrogen content of water, and, tentatively, o suitability of the apparatus to cope with uranium hexafluoride.

W

53

18386 LARGE TEMPERATURE RANGE ANNEALING.

W.Primak.

J. appl. Phys., Vol. 31, No. 9, 1524-33 (Sept., 1960).

Vand's analysis (Abstr. 1684 of 1943) of distributions in a tion energy is reexamined through a new derivation which lead

r approximation to the activation energy spectrum and which
s a treatment of step annealing data. The cases of distribu-
n frequency factor and the twofold distributions in activation
and frequency factor are also treated.

539.219

87 KINETICS OF VACANCY PRECIPITATION IN A SILVER–ZINC SOLID SOLUTION.

wick and A.E.Roswell.
metallurgica, Vol. 7, No. 6, 433-6 (June, 1959).
he anelastic relaxation time in an Ag–33 at. % Zn alloy was
red after quenching by means of static measurements, for a
tative study of the effects of quenched-in vacancies on the
mobility. The data obtained were analysed in terms of the
itation law $dW/dt \cong (1-W)t^{m-1}$ where W is the fraction of
cies annealed out at time t and m is the growth exponent.
arly part of the vacancy decay curve corresponds to m = 2/3.
esults are consistent with the Cottrell–Bilby equation for
ageing. Deformation increases the kinetics of the annealing-
vacancies, indicating that vacancies go to dislocations only in
formed material. S.Weintroub

539.219

388 FRACTIONAL NUCLEATION IN THE AGEING OF AN ALUMINIUM–4.25 wt% COPPER ALLOY.

hate and D.R.F.West.
metallurgica, Vol. 7, No. 6, 436-8 (June, 1959).
ormal and inverse step-quenchings were made, and the incu-
times are listed. The results indicate that the sum of the
onal incubation times for the normal experiments was less
nity, and greater than unity for the inverse. S.Weintroub

539.219

389 DISLOCATION-FREE PRECIPITATES.

D.McLean and K.F.Hale.
metallurgica, Vol. 7, No. 6, 438-9 (June, 1959).
llustrations are given of lath-like precipitates of Mo_2C
cted from a Cr–Mo steel, which were seen in the electron
oscope to be transparent and free from dislocations. There
smoothly curved precipitates, resembling bent whiskers, in
the surface stress was a high as one twentieth of the Young's
lus. S.Weintroub

539.219

8390 PRECIPITATION ON DISLOCATIONS IN ALUMINIUM–4% COPPER ALLOYS

G.Thomas and J.Nutting.
metallurgica, Vol. 7, No. 7, 515-16 (July, 1959).
is pointed out that when a screw dislocation winds up into a
as a result of climb it develops edge characteristics around
linder containing the dislocation line and the Burgers vector.
edge positions are favourable sites for the segregation of
r atoms and precipitates would be expected to form at these
along the helices. Evidence obtained by electron microscopy
films is presented to confirm this view. A.E.Kay

539.219

3391 ON THE PRESSURE OF HYDROGEN IN CAVITIES OF STEEL.

F.de Kazinczy.
metallurgica, Vol. 7, No. 7, 525-7 (July, 1959).
Curves relating the equilibrium pressure of hydrogen with gas
entration at room temperature have been calculated using
odynamic data for the two cases (1) when the gas is held in
nal voids and cavities,(2) when the gas forms a solution in steel.
A.E.Kay

539.219

3392 THE STRUCTURE OF G.P. ZONES IN Al(Ag) ALLOYS.

M.B.Webb.
metallurgica, Vol. 7, No. 11, 748-50 (Nov., 1959).
Reports work which extends that of Walker and Guinier to alloys
compositions ranging from 0.5 to 5 atomic %. In addition, a
what different interpretation of the data is presented. It is
uded that the "fast reaction" in Al–Ag alloys leads to a state
ich all, or almost all, of the Ag has precipitated into roughly
rical clusters whose average volume is approx. proportional to
itial concentration, and whose size distribution function is
narrow. The number of clusters is nearly independent of the
entration and they are not randomly situated but tend to stay
ly separated from one another W.Bardsley

539.219

18393 THE ROLE OF AUSTENITIZING TEMPERATURE IN THE NUCLEATION OF PEARLITE.

M.H.Richman, D.A.Thomas and M.Cohen.
Acta metallurgica, Vol. 7, No. 12, 814-16 (Dec., 1959).

The nucleation rate of the pearlite reaction in pure iron–carbon alloys is found to vary reversibly with austenitizing temperature. Both volume and grain boundary nucleation rates decrease with increasing temperature. The effect may be due to embryo nuclei being stabilized by imperfections in the austenite, or to imperfections surrounded by metastable clusters of carbon atoms acting as nuclei.
H.Mykura

539.219

18394 STRUCTURAL HETEROGENEITIES OF THE SURFACE LAYERS OF THE MAGNETIC ALLOY MUMETAL, HEATED IN THE AIR.

P.A.Jacquet.
Acta metallurgica, Vol. 8, No. 1, 46-9 (Jan., 1960). In French.

Metallographic examination shows structural irregularities which are interpreted as arising from the diffusion of oxygen in layers just below the surface. C.A.Hogarth

539.219

18395 SEGREGATION IN HOMOGENEOUS ALLOYS DURING SINTERING.

G.C.Kuczynski, G.Matsumura and B.D.Cullity.
Acta metallurgica, Vol. 8, No. 3, 209-15 (March, 1960).

The vacancy gradient set up by the sharp curvature of the neck between two sintered particles can under favourable conditions produce a considerable segregation in a completely homogenized solid solution. This effect was demonstrated by the precipitate in Cu–In and Gu–Ag alloys occurring in the neck cavity at a higher temperature than indicated by the solvus line and at a lower one than the solidus temperature. These results are supported by the appearance of side peaks and a shift of the peaks of X-ray lines.

539.219

18396 SOLID SOLUBILITIES OF IMPURITY ELEMENTS IN GERMANIUM AND SILICON.

F.A.Trumbore.
Bell Syst. tech. J., Vol. 39, No. 1, 205-33 (Jan., 1960).

The available data on solid solubilities of impurity elements in germanium and silicon are summarized in the form of solidus or solvus curves. New solubility data are presented for the lead–germanium, zinc–germanium, indium–germanium, antimony–silicon, gallium–silicon and aluminum–silicon systems. The correlation of the solid solubilities with the heats of sublimation and the atom sizes of the impurity elements is considered.
90 references are given.

539.219

18397 ORDERING OF THE SECOND KIND PRODUCED IN AUSTENITE BY INTERMEDIATE TRANSFORMATION.

L.S.Palatnik and I.A.Tananko.
Dokl. Akad. Nauk SSSR, Vol. 133, No. 4, 821-4 (Aug. 1, 1960).
In Russian.

The experiments consisted of high-temperature X-ray examination of Cr–W–Ni alloy steels containing various amounts of C. The complex X-ray patterns observed as a result of various thermal treatments can be interpreted on the basis of the concept of "ordering of the second kind". This is defined as the process whereby on the interstitial lattice sites of a matrix (γ-Fe in this case) which are normally occupied by carbon, there appears a new lattice co-existing with the old and having its own periodicity,etc. A.F.Brown

539.219

18398 TEMPERATURE DEPENDENCE OF THE HALL EFFECT IN THE Ni_3Mn ALLOY.

N.V.Volkenshtein and G.C.Fedorov.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 187-94 (Feb., 1960).
In Russian.

The Hall effect in the Ni_3Mn alloy, both disordered and at various stages of long range order, was studied between 4.2 278° K. It was found that both the spontaneous (R_S) and normal (R_o) Hall constants depend on the manner (rate of cooling) in which the disordered structure has been obtained. R_S and R_o are interdependent and their magnitude changes during the disorder–order transformation. R_o changes its sign after ordering, and the character of its temperature dependence differs from that of the Hall constant of non-ferromagnetic metals. M.H.Sloboda

539.219

18399 X-RAY DIFFRACTION AND X-RAY SPECTROSCOPIC INVESTIGATION OF THE INTERATOMIC BONDING FORCES IN IRON—ALUMINIUM ALLOYS.

S.A.Nemnonov, L.D.Finkel'shtein and K.M.Kolobova.
Fiz. Metallov i Metallovedenie, Vol. 9, No. 2, 243-7 (Feb., 1960).
In Russian.

Based on the work of several other investigators and supported by experimental data on the Debye temperature, Θ, and the ratio ϕ_D/ϕ_A of the fluctuations of the fine structure of the X-ray absorption spectrum of Fe in disordered Fe—Al alloys, a theory of the nature of the interaction between Al and Fe atoms in these alloys is formulated which provides an explanation of the increase of Θ and ϕ_D/ϕ_A with increasing Al content. M.H.Sloboda

539.219

18400 ELECTRON-DIFFRACTION INVESTIGATION OF THE Cu—Sn ALLOY PREPARED BY SIMULTANEOUS CONDENSATION OF THE COMPONENTS ON A GLASS BASE.

L.Grigoresku and I.Teodoresku.
Fiz. tverdogo Tela, Sbornik [Supplement] I, 251-8 (1959). In Russian.

Simultaneous condensation of Cu and Sn vapours on a glass base at room temperature produced all phases of the Cu—Sn alloy, except the ϵ-phase which could be formed by further heat treatment. Condensation on a glass base heated to 200°-250°C produced all the phases of the alloy. When the layers prepared in this way reached a thickness of 200-300 A their structure and properties were identical with those of the bulk samples. A.Tybulewicz

539.219

18401 ON SOME PROPERTIES OF THE CdSb—ZnSb SYSTEM.

I.M.Pilat, G.S.Borodinets, L.A.Kosyachenko and V.I.Maiko.
Fiz. tverdogo Tela, Vol. 2, No. 7, 1522-5 (July, 1960). In Russian.

In addition to microhardness measurements and metallographic examination of CdSb—ZnSb alloys, containing 50-70 mole.% CdSb, the heat conductivity isotherms were constructed and the concentration dependence of the electrical and heat conductivity, thermo-e.m.f., Hall constant and activation energy was determined. The results indicated that an ordered solid solution or an intermetallic compound $ZnCdSb_2$ is formed near the equimolecular composition ZnSb—CdSb. M.H.Sloboda

539.219

18402 METASTABLE SOLID SOLUTIONS IN THE GALLIUM ANTIMONIDE-GERMANIUM PSEUDOBINARY SYSTEM.

P.Duwez, R.H.Willens and W.Klement, Jr.
J. appl. Phys., Vol. 31, No. 8, 1500 (Aug., 1960).

A series of alloys of stoichiometric GaSb and zone-refined Ge were prepared by melting together and rapidly cooling. A single phase was observed in each case and X-ray investigation suggests that Ge substitutes randomly in the GaSb lattice. C.A.Hogarth

539.219

18403 DIRECT OBSERVATION OF ANTIPHASE DOMAIN BOUNDARIES IN THE $AuCu_3$ SUPERLATTICE.

M.J.Marcinkowski and R.M.Fisher.
J. appl. Phys., Vol. 31, No. 9, 1687 (Sept., 1960).

Transmission electron micrographs were obtained of $AuCu_3$ foils prepared by electrothinning. The domain configuration consisted of a network of rectangular blocks with an average size of about 750 A, the boundaries were cube faces. The constrast of the domain boundaries is discussed. J.Franks

539.219

18404 ON AN EXAMPLE OF PROPAGATION IN A DISORDERED MEDIUM.

P.G.De Gennes, P.Lafore and J.P.Millot.
J.Phys. Radium, Vol. 20, No. 6, 624-32 (June, 1959). In French.

The paper deals with propagation phenomena in binary solid solutions AB, the waves being carried by the A atoms only. Such a situation is met in impurity bands in semiconductors, and also for spin waves in alloys with one ferromagnetic component. The influence of accidental clusters formed by A atoms on the eigenvalue spectrum and on the transport properties are investigated. See also Abstr 3268 of 1960.

539.219

18405 PRECIPITATION PROCESS OF CARBON IN ALPHA-IRON.

T.Suzuki and Y.Tomono.
J. Phys. Soc. Japan, Vol. 14, No. 5, 597-601 (May, 1959).

The precipitation process of carbon in alpha-iron was studied by measuring the internal friction, and by observing the precipit with an electron microscope. The experimental results are exp ed fairly well by the formula which expresses the sum of the tw processes, one being the absorption of carbon atoms by the prec tates by way of dislocations and the other being the absorption o carbon atoms through the surfaces of the precipitates by the diffusion-limited process. The observation of the precipitates supports this explanation of the precipitation process.

539.

18406 THE DIFFUSION AND SOLUBILITY OF HYDROGEN THE ALPHA-PHASE OF ZIRCALOY-2.

A.Sawatzk
J. nuclear Mater., Vol. 2, No. 1, 62-8 (March, 1960).

The diffusion of hydrogen in the alpha-phase of Zircaloy-2 measured in the temperature range 260° to 560°C using the gradient technique. The diffusion coefficient was found to be $D = 2.17 \times 10^{-3} \exp(-8380/RT)$ cm²/sec. The terminal solid so bility of hydrogen in Zircaloy-2 was determined in the temperat range 260° to 650°C using a modification of the gradient technique. The solubility is given by $C_0 = 8.50 \times 10^4 \exp(-7600/RT)$ p.p.m. by weight.

539

18407 CONCERNING A FORM OF GRAPHITE CRYSTALS IN PLATINUM—CARBON ALLOY.

I.E.Bolotov.
Kristallografiya, Vol. 4, No. 5, 784-5 (Sept.-Oct., 1959). In Rus
English translation in Soviet Physics—Crystallography (New Yo
Vol. 4, No. 5, 740-1 (May, 1960).

Sulphur is believed to hinder the formation of graphite sphe in cast iron and Ni-C alloys. It was shown that no such effect o in Pt-C alloys. The alloys were prepared from pure materials examined by photomicrography using polarized light. J.The

539.219 : 5

18408 SPECIFIC HEATS OF DILUTE ALLOYS OF MANGA IN SILVER AND COPPER AT LOW TEMPERATURE AND IN MAGNETIC FIELDS.

J.de Nobel and F.J.du Chatenier.
Physica, Vol. 25, No. 10, 969-79 (Oct., 1959).

Results are given of the investigation of the specific heats three silver—manganese and of one copper—manganese alloy in region from 1.3 to 20°K. Measurements were also carried out magnetic fields of 5, 8.6 and 14 kOe. The C/T versus T-curves an anomalous behaviour in that a maximum occurs at low tempe tures. This peak shifts to higher temperatures with increase in concentration. The contribution to the entropy from the solute be estimated and turns out to reach a value between cR ln 5 and cR ln 6 (c= concentration, R = universal gas constant). Magneti fields tend to broaden the peak and to decrease its maximum va The curves for the alloys coincide within the accuracy of the me urements with those for the pure metals in the lower hydrogen region.

5

18409 VARIATION OF THE OPTICAL CONSTANTS AND STRUCTURE OF A THIN GOLD LAYER WITH THE RATE OF FORMATION.

R.Philip.
C.R. Acad. Sci. (Paris), Vol. 250, No. 26, 3974-6 (June 13, 1960
In French.

Gold films were deposited at rates of 0.8, 3 and 25 millimi per minute respectively. For thin films the rate of deposition d not seem to influence the structure or the optical constants. Th films are less compact if deposited slowly, and the optical cons depend on thickness and deposition rate. It is suggested that th deposition takes place in three stages, and in the first stage, th form of the layer is independent of deposition rate. C.Hi

5

18410 MEASUREMENT OF ORIENTATION IN POLYPROPYLENE.FILM.

Z.W.Wilchinsky.
J. appl. Phys., Vol. 31, No. 11, 1969-72 (Nov., 1960).

An average fibre axis orientation in polypropylene film wa measured quantitatively from X-ray diffraction determination o orientation of two planes containing this axis. This orientation expressed as the average square cosine of the angle between th fibre axis and a chosen reference direction in the sample. It w necessary to use an indirect method since there are no crystal planes perpendicular to the fibre axis. The nature of the fibre orientation thus determined was found to be consistent with bir fringence measurements and qualitative deductions from pole f Films produced by flat die extrusion showed a double orientati

he fibre axis is preferentially oriented in the extrusion
on, and the (010) crystal face is parallel to the film surface.
mponents of the orientation tended to be of the same mag-
d

539.23

11 ABSORPTION SPECTRA OF ANODIC NIOBIUM OXIDE FILMS.

raven, R.E.Salomon and G.B.Adams, Jr.
n. Phys., Vol. 33, No. 3, 954-5 (Sept., 1960).
lms of Nb_2O_5, thickness up to 0.7 μ, were prepared by
ving away the unoxidized metal. Spectra of the transmitted
show: (1) interference maxima and minima, from which the
ess is calculated and found to be proportional to the formation
e; and (2) the absorption, commencing at 3450 A and plotted
) A. G.F.Lothian

539.23

412 THE EFFECTS OF SOME IMPURITIES ON THE STRUCTURE OF THIN FILMS OF SELENIUM.

miletov.
llografiya, Vol. 4, No. 4, 629-31 (July-Aug., 1959). In Russian.
h translation in: Soviet Physics—Crystallography (New York),
No. 4, 588-90 (April, 1960).
vaporated amorphous films of selenium containing indium or
m transform on heating to the hexagonal form much more
y than films of pure selenium. The crystal structure is
lly free of defects. C.Hilsum

539.23

413 THE ADHESION OF ALUMINIUM FILMS ON GLASS AFTER IONIC BOMBARDMENT. N.A.Florescu.

m, Vol. 7-8, 46-55 (1957-58: publ. April, 1959).
xperiments were performed with the purpose of explaining
he mechanism of the process called cleaning by ion bombard-
applied to glass surfaces prior to the deposition of films, and
ermining the conditions for carrying out such a process in
to secure good film adhesion on the supporting surface. As
for film adhesion, the process of anodising was used. Three
experimental observations are recorded: (1) the presence of
sorbed skin of molecules on the target surface; (2) the
t appearance of the effect; and (3) the destruction of this
by rubbing. These confirm the suggestion that the high
ion of the deposit following the electrical treatment is due to
eation of numerous centres of condensation by electrically
ed gas molecules adsorbed on the surface. With regard to the
cal usefulness of the process, the optimum values of various
s which influence the process are given.

539.23

8414 HOMOGENEOUS AND HETEROGENEOUS EVAPORATED FILMS IN ANTIMONY. E Ruedl.

m, Vol. 7-8, 56-60 (1957-58: publ. April, 1959).
ntimony deposits produced by vacuum evaporation show a
y of structures. Initially, while the deposit is very thin, it is
hous throughout. Thick films are known to be fully crystallis-
part from these two homogeneous forms, films of a heterogene-
ructure are known. This type of structure was in the past
lered to result from a variation of thickness within the film.
uthor reports on methodical experiments using different evap-
n speeds producing deposits of a thickness ranging from
000 A and conducted with the particular objective of studying
ystallisation mechanism in heterogeneous films.

539.23 : 537.54

415 THIN CARBON FILMS FOR USE WITH ELECTROSTATIC ACCELERATORS. N.Sarma.

ar Instrum., Vol. 2, No. 4, 361-2 (May, 1958).
For evaporation targets, glass microscope slides were cleaned
ughly and a thin layer of NaCl was evaporated on to them. It
ound necessary to use single crystals of NaCl to prevent
sition of large particles on the slide. Carbon was then
rated onto the NaCl by passing a current of 100 A through a
n arc for periods of about 10 sec, separated by 30 sec intervals,
deposit of the required thickness was obtained. The inter-
nt heating was necessary because heating of the carbon
rodes caused rapid outgassing with consequent rise in pressure
work chamber. The coated slide was then removed from the
m and was steadily lowered at an angle into a dish of warm
. The substrate of NaCl dissolved off leaving the carbon film
ng on the surface.

539.23 : 539.16

PREPARATION OF THIN BETA-RAY SOURCES BY EVAPORATION AND CATHODE SPUTTERING. See Abstr. 17516

X-ray and Electron Microscope Examination

539.26

18416 NEUTRON [DIFFRACTION] STUDY OF THE CRYSTALLINE TEXTURE OF URANIUM BARS.

J.Laniesse, P.Meriel and M.Englander.

J. nuclear Mater., Vol. 2, No. 1, 69-74 (March, 1960). In French.

The method of studying textures by neutron diffraction has been applied to uranium bar extruded in the α range at 600° C. When textures are determined by X-ray diffraction, the thickness of metal through which the X-ray beam can pass is slight in the case of absorbent materials; it is therefore necessary to carry out analyses on a large number of sections to obtain a statistically significant result. Since neutrons are not strongly absorbed by most substances of high atomic weight, it is possible by means of a single series of experiments to obtain a good statistical image of the texture. The specimen is a cylinder of about 5 cm^3, the axis of which, normal to the direction of drawing, coincides with the axis of a beam of monochromatic neutrons (λ = 1.143 A). The neutron detector is a BF_3 counter which moves in a circle in a horizontal plane, centred on the specimen. The diffraction spectrum obtained from a piece of uranium bar, extruded in the α-range and treated in the β-range, has shown that this specimen has only a weak degree of preferred orientation, whereas an as extruded specimen shows a marked [110] texture in the direction of extrusion. The results obtained are in agreement with those determined by X-ray diffraction by various authors with uranium bars extruded or rolled in the α-range.

539.27

18417 X-RAY MICROSCOPY OF BERYLLIUM.

J.Sawkill and D.R.Schwarzenberger.

Brit. J. appl. Phys., Vol. 11, No. 11, 498-503 (1960).

The point-projection X-ray microscope was used to study a variety of beryllium specimens, ranging from single crystals to finely-polycrystalline metal containing inclusions. The highly divergent beam of X-rays from a source 1 μ in diameter gives, on the same photograph, a microradiograph of the specimen with a resolution of 1 μ and a divergent beam diffraction pattern. Together these can give information about the distribution of heavier elements or cracks in the beryllium, the variation in perfection of the crystal lattice and, with a single crystal, the orientation and lattice parameters of the specimen.

539.27

18418 DIRECT OBSERVATION OF SUB-STRUCTURES IN MARTENSITE. Z.Nishiyama and K.Shimizu.

Acta metallurgica, Vol. 7, No. 6, 432-3 (June, 1959).

Electron micrographs of thin martensite plates of a Fe—30.64% Ni alloy show straight parallel lines, with a spacing of 100-400 A between the two unit fringes, of the same order as that of the fine bands found in electron micrographs of the surface relief and reported earlier by Nishiyama, Shimizu and Sato, [Memoirs of the Institute of Scientific and Industrial Research, Osaka University, Vol. 13, 1 (1956)]. S.Weintroub

539.27

18419 CONTRAST OF ELECTRON MICROGRAPHS.

J.S.Halliday and T.F.J.Quinn.

Brit. J. appl. Phys., Vol. 11, No. 11, 486-91 (1960).

The variations of contrast in electron micrographs of amorphous films, with film thickness, electron accelerating voltage and objective aperture angle, are discussed; elastic and inelastic electron scattering and the possibility of plural scattering are taken into account. Experimental results, obtained with vacuum-evaporated iron films, confirm a formula of the type first proposed by Hall (Abstr. 5458 of 1951). However, the contrast is about four times smaller than predicted, using scattering cross-sections based on Lenz's (Abstr. 7490 of 1954) data. Results for other materials, obtained by previous workers, indicate similar discrepancies. At present, the likeliest explanation appears to be a theoretical underestimation of the scattering into angles smaller than 10^{-3} rad. The limitations of contrast measurements for assessing specimen thickness or constitution are discussed, and a new criterion for replica and shadowing materials suggested.

539.27 : 537.533

18420 SELECTED-AREA DIFFRACTION IN THE ELECTRON MICROSCOPE. R.Phillips.

Brit. J. appl. Phys., Vol. 11, No. 11, 504-6 (1960).

A direct demonstration is given of the error in the area contribution to the recorded diffraction pattern, which arises from use of the incorrect objective focal length in microdiffraction experiments in the electron microscope. The effect of errors in the final intermediate lens setting is also discussed, and reproducibility of the camera constant λL in selected area diffraction is investigated. Agar (Abstr. 7158 of 1960) has emphasized that a certain operational procedure has to be closely followed, if a selected area diffraction pattern in a three-stage electron microscope is to come solely from the area defined by the selector aperture under magnified image conditions. The contributions which may occur from an annulus outside the image of the aperture, due to incorrect excitation of the objective lens, are demonstrated. The reproducibility of λL is discussed.

539.27

18421 STUDY OF BACKGROUND STRUCTURE IN PLATINUM/CARBON SHADOWING DEPOSITS. D.E.Bradley.

Brit. J. appl. Phys., Vol. 11, No. 11, 506-9 (1960).

The aggregation of metal shadowing deposits into small crystallites causes a background structure well known to electron microscopists. A different structure has been found to occur with amorphous shadowing materials. The form of the structure is described and it is shown that the main cause is the hydrocarbon deposit formed on surfaces in the evaporating unit. The effect of the statistical distribution of the shadowing atoms on the ultimate resolution obtainable is discussed.

539.27

18422 STUDY OF THIN GLASS FIBRES AND FILMS. M.Navez and C.Sella.

C.R. Acad. Sci.(Paris), Vol. 251, No. 4, 529-31 (July 25, 1960). In French.

Thin glass films suitable for electron microscopy are made by suddenly blowing a bubble of heated glass. To avoid atmospheric contamination, the films are examined immediately. Silicate glasses show various microphases with granules about 200 A in size which are rich in silica. By following the thermal treatment of glass in the microscope, this granulation sets in at temperatures above 500°C. Many films have thin fibres at their edges which have a similar microstructure. R.I

53

18423 DIRECT REPLICA TECHNIQUE FOR COPPER. J.O.Stiegler and T.S.Noggle.

J. appl. Phys., Vol. 31, No. 10, 1827-8 (Oct., 1960).

Carbon replicas could easily be removed from Cu surfaces exposure to nitric acid fumes and dissolution of the thin oxide la on the Cu surface in a dilute aqueous solution of ethylenediamin Examples are given of the high quality of the replicas even after stripping from rough surfaces. J.Fr.

53

18424 ELECTRONMICROSCOPIC OBSERVATIONS OF THE KCl SINGLE CRYSTAL IRRADIATED WITH ULTRA VIOLET LIGHT. T.Tomiki and M.Ueta.

J. Phys. Soc. Japan, Vol. 14, No. 5, 602-8 (May, 1959).

Electronmicroscopic observations were made of a KCl sing crystal irradiated with light emitted from a hydrogen discharge using the replica technique. Growth of crystallites occurred on irradiated surface, and irradiation effects could also be detecte inside the crystal to the depth of 5-7μ beneath the irradiated su face. It was confirmed experimentally that the growth of crysta was induced by the ionic motions inside the irradiated crystal. mechanism by which crystallites were formed is discussed in relation to the action of excitons.

53

18425 THE PRODUCTION OF EVAPORATED LAYERS WI THE HELP OF A SMALL VAPOUR SOURCE HEAT BY ELECTRON BOMBARDMENT. H.Westmeyer and E.Lorenz

Optik, Vol. 17, No. 5, 244-8 (May, 1960). In German.

An apparatus is described for the production of electron microscope preparations. They are exposed to evaporated carb and carbon–platinum or other materials, incident both directly and obliquely. The heating effect is achieved by electron bomba ment.

539.27 : 537

ION-BOMBARDMENT ETCHING OF FIBRE SAMPLES FO ELECTRON MICROSCOPY. See Abstr. 17052

PHYSICAL CHEMISTRY

541

18426 MATHEMATICAL BOTTLENECKS IN THEORETICAL CHEMISTRY. J.O.Hirschfelder.

Frontiers of numerical mathematics symposium, Wisconsin, 1959 (See Abstr. 12232 of 1960) Paper Six, p. 83-95.

The author points out three fields in which progress in basic mathematics is badly wanted. The exact solution of the Schrödinger equation for molecules seems hopelessly intractable yet some of the approximate methods in use work surprisingly well, the reasons for which are not at all clear. Little is known of the generalization of the Boltzmann equation to dense systems. No one has yet formulated the problem of chemical reaction rates in a form suitable for obtaining practical solutions. H.N.V.Temperley

THERMOCHEMISTRY . REACTIONS

541.12

18427 MASS SPECTRA OF VAPORS IN THE Al–AlF_3 AND Al–LiF–AlF_3 SYSTEMS. R.F.Porter.

J. chem. Phys., Vol. 33, No. 3, 951-2 (Sept., 1960).

For 100 V ionizing electrons, the major ions observed in the vapours associated with both mixtures are AlF^+, Al^+, and AlF_2^+ with a high intensity of Li^+ also present with the Al–LiF–AlF_3 system. G.I.W.Llewelyn

541.12 : 539.18

SEPARATION OF BORON ISOTOPES : THE METHYL SULPHIDE–BF_3 SYSTEM. See Abstr. 17676

54

18428 SURFACE CATALYZED EXCITATION WITH N AND ATOMS. G.G.Mannella, R.R.Reeves and P.Harteck.

J. chem. Phys., Vol. 33, No. 2, 636-7 (Aug., 1960).

For previous work see Abstr. 6403 of 1960. Spectroscopic studies of the light emitted near the surface of the catalysts indi that the primary products formed are:- N_2 and NO on Ni and N_2 Co. An explanation of the observed bands in terms of the energy levels of the excited species is given and the lifetimes derived a with those calculated from thickness of the glowing film of gas. results obtained with Ag and Cu are also discussed. G.H.C.Free

541

18429 RECOMBINATION OF OXYGEN ATOMS IN THE ABSENCE OF O_3.

J.E.Morgan, L.Elias and H.I.Schiff.

J. chem. Phys., Vol. 33, No. 3, 930-1 (Sept., 1960).

The recombination rate of O atoms is determined where the mechanism involving the ozone intermediate is precluded. Detai of the measurement of O atom concentration by two different methods are given. G.I.W.Llew

54

18430 RECOMBINATION KINETICS OF ATOMIC OXYGEN ROOM TEMPERATURE.

C.B.Kretschmer and H.L.Petersen.

J. chem. Phys., Vol. 33, No. 3, 948-9 (Sept., 1960).

Measurement of the afterglow produced by reaction of oxyge atoms with NO following partial dissociation in an electrodeless discharge enables the O-atom concentration to be determined. The effect of dissociated water vapour on the recombination rat has also been investigated. G.I.W.Llew

541.12

1 MECHANISM OF OZONE DECOMPOSITION.
H.J Schumacher.
. Phys., Vol. 33, No. 3, 938-9 (Sept., 1960).

ctions proposed by Benson (Abstr. 8237, 8244 of 1957) for the ism of O_3 decomposition are criticized and evidence indi- he existence of energy chains in this reaction is discussed.

G.I.W.Llewelyn

541.12

2 ON THE EXISTENCE OF ENERGY CHAINS IN OZONE DECOMPOSITION. S.W.Benson.
. Phys., Vol. 33, No. 3, 939-40 (Sept., 1960).

lemical with preceding abstract. A mechanism for O_3 thermal osition over the range 5-254° C is postulated and the effects resence of trace catalysts briefly discussed. It is claimed ergy chains cannot be attributed to vibrationally excited O_2 y to excited O atoms.

G.I.W.Llewelyn

541.12

33 A CUBE-ROOT LAW FOR THE ACTIVITY COEFFICIENT QUOTIENT OF THE DISSOCIATION OF HSO_4^- ION.
alrafen.
n. Phys., Vol. 33, No. 3, 947-8 (Sept., 1960).

e dissociation of the HSO_4^- ion in concentrated aqueous ns of sulphuric acid is studied by plotting log Q_f against ere Q_f is the quotient of activity coefficients and I is the ted ionic strength. Deviation from straightness is interpreted.

G.I.W.Llewelyn

541.12

34 METASTABLE STATES OF ACRIDINE ORANGE IN SOLUTION. G.Blauer and H.Linschitz.
n. Phys., Vol. 33, No. 3, 937-8 (Sept., 1960).

ash-excitation was used to investigate the decay of the able states of both ionized and un-ionized forms of acridine at room temperature. Two metastable states of different es have been detected but not identified.

G.I.W.Llewelyn

541.12

35 THE HEATS OF FORMATION OF BF_2Cl AND $BFCl_2$.
S.R.Gunn and R.H.Sanborn.
m. Phys., Vol. 33, No. 3, 955-6 (Sept., 1960).

he heat of reaction of $BF_3 + BCl_3 = BF_2Cl + BFCl_2$ is deduced. les of possible BF_3—BCl_3 equilibria are considered and the orium constants of the various systems calculated.

G.I.W.Llewelyn

541.12

436 DETERMINATION OF FLAME VELOCITIES IN GASEOUS PREDETONATION.
echt, A.J.Laderman, R.A.Stern and A.K.Oppenheim.
sci. Instrum., Vol. 31, No. 10, 1107-11 (Oct., 1960).

he application of ionization gap or "pin" probes to measure velocities during the development of detonation is presented. construction and circuit techniques are described which, e the widely varying character of the ionization signals in this , yield timing precision of 2% or less for hydrogen—oxygen res. Analysis of the ionization probe circuit permits the fication of the probe signal with the ionization levels encountered various waves generated during the development of detonation. manner it is possible to differentiate between shocks, flames, etonation waves and to determine the axial flame velocity e.

541.12

437 EXPERIMENTAL INVESTIGATION OF THE COMBUSTION OF TWO-PHASE MIXTURES IN A BULENT STREAM.
B.P.Lebedev and V.G.Tikhomirov.
ekh. Fiz., Vol. 30, No. 8, 994-1005 (Aug., 1960). In Russian.

The characteristics of the flame propagation and the dimen- of the zone of combustion were investigated in the open tongue me of a two-phase paraffin—air mixture. The flame velocity sentially influenced by the turbulence in the incident mixture m (including the supplementary turbulence due to the injection liquid fuel) and by the temperature of the mixture. The time mbustion depends primarily on the size of fuel drops and the erature.

F.Lachman

541.12 : 534.22

N THE STRUCTURE OF PLANE DETONATION WAVES.
bstr. 16772

PHOTOCHEMISTRY RADIATION CHEMISTRY

541.14 : 539.2 : 537.312

PHOTOLYSIS IN CADMIUM IODIDE. See Abstr. 18066

541.15

18438 EFFECTS OF LINEAR ENERGY TRANSFER ON THE RADIOLYSIS OF WATER AND HEAVY WATER.
E.Collinson, F.S.Dainton and J.Kroh.
Nature (London), Vol. 187, 475-7 (Aug. 6, 1960).

The radiolysis of water can be described quantitatively in terms of the yield of the free radicals H·, OH· and HO_2· and the yield of H_2 and H_2O_2. The relative amounts can be measured using the solutes: ferrous ions, ceric ions, and a mixture of ceric and thallous ions. Po^{210} α-particles were used as a radiation source and the linear energy transfer (LET) varied by utilizing discrete parts of the α-particle track. $G(Fe^{3+})$ decreases steadily. When tritium β-particles were used the following values were found: $G(Ce^{3+}) = 2.84$; $G_H = 2.9$; $G_{OH} = 2.1$; $G_{H_2O_2} = 1.0$; $G_{H_2} = 0.6$ for acidified water. Since this is close to yields obtained with Co γ-radiation, $G(Ce^{3+})$ has a maximum at an LET intermediate between Po α-particles and tritium β-particles. Using heavy water, an isotope effect similar to that for γ- and X-rays was found, which was highest for an LET corresponding to low-energy α-particles. Differences in the initial rates of formation and decomposition of hydrogen peroxide and deuterium peroxide were observed.

M.Ebert

541.15

18439 E.P.R. OBSERVATION OF STEADY-STATE ETHYL RADICAL CONCENTRATION IN RADIOLYSIS OF LIQUID ETHANE.
R.W.Fessenden and R.H.Schuler.
J. chem. Phys., Vol. 33, No. 3, 935-6 (Sept., 1960).

The spectrum which was identified by its hyperfine structure as due to ethyl radicals was observed during irradiation with 2.5 MeV electrons. By comparison with known samples the radical concentration was estimated as 7×10^{-8} molar for 0.1 μA beam current, and was found to be proportional to the square root of the current.

E.F.W.Seymour

541.15

18440 IRRADIATION OF GASEOUS AND LIQUID OXYGEN.
J.F.Kircher, J.S.McNulty, J.L.McFarling and A.Levy.
Radiation Research, Vol. 13, No. 3, 452-65 (Sept., 1960).

Aviator's breathing oxygen was γ-irradiated in the gaseous and in the liquid states under a variety of controlled temperatures, pressures, times and dose rates. It was then analysed for ozone and nitrogen oxides. In gaseous oxygen, ozone reached a peak concentration with 10^5 rads total dose then decreased to steady-state concentration with 10^7 rads total dose regardless of temperature, pressure, or dose rate. The peak and the steady-state ozone concentrations increased with increasing dose rate and decreased with increasing temperature. In liquid oxygen, ozone concentration increased linearly with total dose, regardless of dose rate or magnitude of total dose. Minimum G values for ozone formation were 9 for gaseous-state and 6 for liquid-state irradiations. An apparent activation energy calculated from these studies suggests that the maximum and the steady-state ozone concentrations are related to a secondary atom-molecule reaction. Nitrogen oxide yields were always small but seemed to be significant in their effects on the mechanism of ozone formation.

541.15

18441 EFFECT OF SOLID SUBSTANCES ON THE PROCESS OF DECOMPOSITION OF CCl_4 IN AQUEOUS SOLUTION, INDUCED BY GAMMA RADIATION.
A.S.Baberkin, N.P.Krushinskaya and M.A.Proskurnin.
Dokl. Akad. Nauk SSSR, Vol. 132, No. 6, 1329-31 (June 21, 1960). In Russian.

When irradiated with gamma-rays from Co^{60} the 1 : 2 mixture of CCl_4 and H_2O was found to contain more Cl^- ions for larger irradiation doses (no proportionality). No changes in yields were observed when O_2 was bubbled instead of N_2. When experiments were carried out in the presence of solids (Al_2O_3, silica gel, Fe_2O_3, carbon and Cu_2O) it was found that (1) yields of Cl^- increased with increasing proportions of solids, (2) yields increased from

Al_2O_3 to Cu_2O in the order referred to above for equal proportions of solids, and (3) the presence of solids manifested only when O_2 was bubbled through the liquid. F.Lachman

541.15

18442 ENERGY TRANSFER IN LIQUID HYDROCARBONS EXCITED BY γ RAYS. G.R.Freeman.

J. chem. Phys., Vol. 33, No. 3, 957-8 (Sept., 1960).

When solutions of benzene in cyclohexane are exposed to γ-radiation the kinetics suggest that either excitation energy is transferred from the solvent molecule to benzene, or electron transfer occurs in the opposite direction. A comparison with results obtained for benzene in methylcyclohexane seems to indicate that charge transfer is an important mechanism with transfer times of 10^{-14} to 10^{-16} sec. This rapid charge transfer is consistent with the view that a positive charge belongs to a domain within the liquid containing several molecules. The existence of such domains in solvents is discussed. M.Ebert

DISPERSIONS . COLLOIDS ADSORPTION

541.18

18443 SPECIFIC HEAT OF COLLOIDS. I. G.R.Phansalkar.

J. sci. Res. Banaras Hindu Univ., Vol. 9(1), 29.35 (1958-59: publ. Dec., 1958).

The paper gives brief details of the experimental method for, and results of the determination of the specific heats of sols of antimony sulphide, arsenious sulphide, cadmium sulphide, gambodge, gumdammar, ferric hydroxide, manganese dioxide, molybdenum blue and gold. See following abstracts. E.G.Knowles

541.18

18444 SPECIFIC HEAT OF COLLOIDS. II. INFLUENCE OF COLLOID CONCENTRATION. G.R.Phansalkar.

J. sci. Res. Banaras Hindu Univ., Vol. 9(2), 55-9 (1959-60: publ. June, 1959).

Using the method described in Pt I (see preceding abstract) results are obtained for the variation of specific heat with colloid concentration. A discussion of the results is included.

E.G.Knowles

541.18

18445 SPECIFIC HEAT OF COLLOIDS. III. INFLUENCE OF TEMPERATURE.G.R.Phansalkar.

J. sci. Res. Banaras Hindu Univ., Vol. 9(2), 60-2 (1959-60: publ. June, 1959).

This paper continues the work noted in the preceding abstracts. A brief discussion of the significance of the results is included.

E.G.Knowles

541.18 : 535.8 : 621.317.39

18446 SMOKE DENSITY INTEGRATOR. R.M.Storey.

Brit. J. appl. Phys., Vol. 11, No. 11, 509-12 (1960).

A simple instrument is described which both indicates and integrates the optical density of smoke in the range 0 to 1.0 optical density per foot. It consists of a detector unit exposed to the smoke and a remote control unit containing the indicator and integrator. A barrier-layer photocell, mounted within the detector unit, is loaded to give a logarithmic light intensity-voltage characteristic, so that a smoke obeying the Beer—Lambert law gives rise to a linear decrease in cell voltage with increasing optical density. Integration is achieved by means of a capacitor charged by the out-of-balance current of a self-rectifying a.c. bridge, in which the impedance of one arm is controlled by the photocell output. The overall stability over twenty-four hours is of the order of ±6%.

541.18 : 621.383.4

18447 RAPID COUNTER FOR SMALL PARTICLES IN SUSPENSION. J.B.Cornwall and R.M.Davison.

J. sci. Instrum., Vol. 37, No. 11, 414-17 (Nov., 1960).

Equipment based on a photoelectric detection method is described which has been designed for counting apple cells (approximate size distribution 70-500 μ length) but which may be
used with any reasonably opaque particles of suitable size whi
be held in suspension in a clear low-viscosity liquid. The acc
of a single run is about ±3% including sampling errors. This
may be reduced by averaging several samples.

18448 PARTIAL ADSORPTION OF THE COMPONENTS C RESIDUAL GASES IN A VERY HIGH VACUUM.

N.D.Morgulis, Yu.G.Ptushinskii and B.A.Chuikov.

Dokl. Akad. Nauk SSSR, Vol. 128, No. 5, 930-2 (Oct. 11, 1959). Russian.

The flash method (Abstr. 2497, 7838 of 1954) was used. A
tungsten ribbon was purified at a high temperature, cooled to
temperature (at which residual gases could be absorbed) and,
after a 30 min exposure, heated for a short time to a high tem
ture. The desorbed gases produced a short-lived pressure ris
(flash), and the ionization increment was recorded mass-spect
metrically for each component. It was found that the mean pr
bility of condensation of He is zero, while the probabilities for
and N_2 are roughly equal. F.La

5

18449 AN ALL-METAL APPARATUS FOR THE DETERM TION OF SPECIFIC SURFACE BY GAS ADSORPTI

A.S.Joy.

Vacuum, Vol. 7-8, 30-7 (1957-58: publ. April, 1959).

A gas adsorption apparatus is described in which the conv
al glass items such as stopcocks and mercury-filled manomet
replaced by metal valves and multi-pointer capsule gauges. T
apparatus can be used by semi-skilled operators to obtain com
adsorption isotherms, single or two-point comparison values,
rates of diffusion into micro-porous solids.

5

18450 ON THE THEORY OF A DISTILLATION COMBINE WITH ABSORPTION. P.J.Bruijn and W.R.Van Wij

Physica, Vol. 25, No. 10, 935-44 (Oct., 1959).

The theory of a process consisting of a combination of a li
absorption and a distillation (rectifying absorption) is given. It
shown that in case of negligible volatility of the absorption liqu
theory can be reduced to that of a pure distillation. A numeric
example is given.

5

18451 APPARATUS FOR MEASUREMENT OF SORPTION REACTIVE CONDENSABLE VAPOURS UP TO 350°

R.M.Barrer and S.Wasilewski.

J. sci. Instrum., Vol. 37, No. 11, 432-4 (Nov., 1960).

An apparatus for the measurement of sorption of reactive
condensable vapours at temperatures up to 350°C and pressure
range 0.1-760 mm of mercury is described. It is composed
essentially of a wholly enclosed Pyrex-glass balance system,
incorporating a silica spring balance, a sensitive platinum resi
thermometer and a spiral pressure gauge; the whole unit being
surrounded by electric furnaces. The pressure and temperatu
measurement and control are also described. The amount sor
can be measured with accuracy to 0.03 mg; pressure to at leas
0.05 mm of mercury; temperature to 0.01°C.

5

18452 THE DIPOLE MOMENT AND NATURE OF THE CHEMISORPTION BOND.

R.Culver, J. Pritchard and F.C.Tompkins.

Z. Elektrochem., Vol. 63, No. 7, 741-5 (1959).

Experimental results are given for the change of work func
of three sp metals, copper, silver, gold, and of three transitio
metals, iron cobalt, nickel, when hydrogen and carbon monoxid
separately chemisorbed at −192°C on these metals in the form
an evaporated film, using the space-charge limited diode metho
With the sp metals a predominantly electrostatic bond is form
the dipole moment of which is largely controlled by the first io
zation potential of the adsorbate and that of the atom of the ads
bent. This bonding is additional to the normal dispersion force
which usually are the most significant contribution to the for
operative in the ordinary van der Waals or physical adsorption.
With the transition metals, definite covalent bonding involving
d-atomic orbitals takes place — these are hybrid bonds, the ch
ter of which changes with increasing coverage of the adsorbent
faces; these conclusions are consistent with those drawn from
red spectrometric studies of other authors. The contribution o

omponent to the heat of adsorption and to the variation of t with coverage is not large for the transition metals but is ntial one with the sp metals.

PHYSICAL METHODS OF CHEMICAL ANALYSIS

545

3 DETERMINATION OF ACTIVE HYDROGEN USING EXCHANGE WITH DEUTERIUM. INFRARED ROPHOTOMETRIC METHOD. W.R.Harp, Jr and R.C.Eiffert.
Chem., Vol. 32, No. 7, 794-6 (June, 1960).

generalized infrared method for the determination of active en involves exchanging the active hydrogen in the sample uterium of D_2O. The sample is mixed with a relatively large of D_2O and the amount of active hydrogen calculated accord- he method of Gaunt from the intensity of the 2.97-micron OH nerated in the D_2O. Water-soluble or insoluble samples may in about $\frac{1}{2}$ hour with an accuracy to about 2% of the amount of hydrogen present.

545

54 THE CENTENNIAL OF SPECTROCHEMISTRY — PRESENTED AT THE WASHINGTON MEETING OF THE AL SOCIETY OF AMERICA, APRIL 7, 1960.
eggers and J.L.Tech.
Soc. Amer., Vol. 50, No. 11, 1035-8 (Nov., 1960).

e birth and growth of spectrochemistry are reviewed on the on of its centennial. The origin of spectrochemistry is found two classical memoirs published by Bunsen and Kirchhoff a y ago in Poggendorff's Annalen, in which they gave the first e and general answer to the question as to whether the bright n the spectrum of a glowing gas are dependent exclusively on mical composition. The foundations of astrophysics and a on the first discovery of a new chemical element by spectral is (caesium) are also found there. Short biographical es of Bunsen and Kirchhoff are given, and the major conclusions of their two famous memoirs are cited. The growth of this new method of chemical analysis is then briefly traced to this centennial year, when such analyses are already being widely made in science and technology by electronic automation.

545

18455 A RAPID RADIOMETRIC DETERMINATION OF URANIUM AND OF THORIUM IN COMPLEX ORES.
G.Jurain and J.P.Maillot.
J. Phys. Radium, Vol. 19, Suppl. No. 4, 35A-38A (April, 1958).

Two gamma-activity measurements were made, with the aid of an assembly of NaI:Tl scintillation detectors by fixing two gain values for the preamplifer. These two results were compared with a standard measurement, and a calculation of the percentages of U and Th made. This method is only applicable for ores in radioactive equilibrium.

545

18456 AN X-RAY FLUORESCENCE METHOD FOR DETERMINATION OF THE TRANSITION-METAL CONTENT IN VERY SMALL SPECIMENS OF ALLOYS. P.J.Brown.
J. sci. Instrum., Vol. 37, No. 10, 394-7 (Oct., 1960).

A method is described for the quanitative determination of the transition metal content in very small quantities of alloys containing transition metals of the first long period. The method depends upon measurement of the intensity of the fluorescent X-rays emitted by the specimen, and the results are evaluated by comparison with a series of standards. An accuracy of better than 1% can be achieved in specimens containing as little as 0.2 mg of the transition metals.

545

18457 SURFACE ANALYSIS BY CHARGED PARTICLE SPECTROSCOPY. S.Rubin.
Nuclear Instrum. and Methods, Vol. 5, No. 3, 177-83 (Sept., 1959).

The analysis of the momentum distribution of protons scattered from a solid surface can be used to determine the composition of the surface as a function of depth. Examples of such analyses obtained with a 2 MeV Van de Graaff accelerator and a high resolution magnetic spectrometer are given. The technique is applicable to the detection of all elements to a depth of several microns, with sensitivities in the range of 10^{-8} to 10^{-6} gm cm^{-2}.

GEOPHYSICS

550.3

458 GEOMAGNETIC DYNAMOS.
A.Herzenberg.
Geophys., Vol. 14, No. 4, 522-5 (1958).

his report outlines a proof that it is possible to postulate a n of motions in a homogeneous sphere of isotropic conducting ial such that the whole arrangement acts as a steady dynamo pro- g a magnetic field extending outside the sphere. There can there- e no general theorem to rule out the possibility that the geomag- field is due to a dynamo in the earth's core. The proof is ous; it uses a model consisting of two eddies in the earth's and does no more than provide an existence theorem; it is uggested that the motions in the earth's core have the simple assumed.

550.3

459 THE "EDDY MODEL" OF THE NON-DIPOLE FIELD AND THE SECULAR VARIATION.
rzenberg and F.J.Lowes.
Geophys., Vol. 14, No. 4, 526-9 (1958).

Bullard's eddy model (Abstr. 1881 of 1950) has been extended low for the effect of the stationary conducting material sur- ding the eddies, and the boundary of the surrounding conductor. ideration of the available power and an electromagnetic satu- n effect show that eddies capable of producing the non-dipole must have radii of several hundred kilometres. To enable the ng field of such large eddies to reach the surface of the core necessary to postulate hydromagnetic propagation.

550.3

18460 GEOMAGNETIC STORMS AND THE SPACE AROUND THE EARTH. S.Chapman.
Nature (London), Vol. 187, 824-7 (Sept. 3, 1960).

A review paper. No references are given. A.Boksenberg

550.3

18461 A GIANT GEOMAGNETIC PULSATION.
J.Veldkamp.
J. atmos. terrest. Phys., Vol. 17, No. 4, 320-4 (Feb., 1960).

A giant geomagnetic pulsation, which occurred on 17 July 1958, was recorded in many European observatories between 50° and 60° geomagnetic latitude. The movements (with periods of about 100 sec) are coherent in only a small part of the area in which they are recorded. The greatest amplitudes (25γ) are found in a strip following the circles of geomagnetic latitude. Comparisons are made with theories of Obayashi and Jacobs (Abstr. 3604 of 1958) and Scholte (see following abstract).

550.3

18462 ON THE THEORY OF GIANT PULSATIONS.
J.G.J.Scholte.
J. atmos. terrest. Phys., Vol. 17, No. 4, 325-36 (Feb., 1960).

The propagation of a magneto-ionic disturbance originating in a small region of the exosphere has been investigated; it appears that only a rotational movement perpendicular to the geomagnetic field is propagated without any great loss of energy. The amplitude of a compressional movement perpendicular to this field decreases with increasing distance to the source, whereas a movement parallel to the magnetic field is propagated as a sound wave without any magnetic effect. Therefore the observed giant pulsations, which are ascribed to standing waves along the lines of force, are mainly caused by the rotational part of the primary disturbance and the properties of these variations are closely connected with the properties of that part of the original movement.

550.3

18463 GREAT MAGNETIC STORM OF MARCH 31-APRIL 3, 1960. D.L.Chinburg.

J. geophys. Res., Vol. 65, No. 7, 2206-8 (July, 1960).

Presentation of measurements of the scalar magnitude of the geomagnetic field vector F during this very intense storm.

C.Hazard

550.3

18464 SEVERE MAGNETIC STORMS RECORDED AT KAKIOKA [JAPAN]. Y.Yokouchi.

Rep. Ionosphere Res. Japan, Vol. 12, No. 1, 42-3 (March, 1958).

Data for 12 severe geomagnetic disturbances occurring between July, 1927 and February, 1958 are tabulated. D.R.Barber

550.3

18465 THE INITIAL PHASE OF THE MAGNETIC STORM OF FEB. 11, 1958. N.Fukushima and S.Abe.

Rep. Ionosphere Res. Japan, Vol.12, No. 1, 44-9 (March, 1958).

An intense geomagnetic disturbance, with auroral activity visible over central Japan, was recorded at $01^{h}26^{m}$ GMT on 11 February, 1958. Details of the initial phase of this storm are noted, and compared with similar data for an earlier disturbance on 24 January, 1949. D.R.Barber

550.3

18466 ON THE ELECTRIC FIELD OF THE POLAR MAGNETIC STORM. S.Akasofu.

Rep. Ionosphere Space Res. Japan, Vol. 12, No. 3, 268-72 (Sept., 1958).

The origin is examined of the electromotive force of the polar magnetic storms in relation to phenomena involving aurorae and polar blackouts. It is suggested that the proton and electron streams entering the ionosphere have a common and powerful polarization electric field between them which might give rise to the currents of the polar magnetic storms between their narrow impact zones in the ionosphere. It is found that this problem is closely related to whether the idealized current-systems, S_D (or D_S) and D_{st}, suffice to support polar magnetic storms.

550.3

18467 LARGE-SCALE AURORAL MOTIONS AND POLAR MAGNETIC DISTURBANCES. I. A POLAR DISTURBANCE AT ABOUT 1100 HOURS ON 23 SEPTEMBER 1957. S.I.Akasofu.

J. atmos terrest. Phys., Vol. 19, No. 1, 10-25 (Sept., 1960).

The nature of polar magnetic disturbances associated with large-scale auroral motions is studied, with particular reference to one of the remarkable magnetic and auroral events of 23 September 1957. It is concluded that both the westward auroral electrojet and the eastward auroral motion are produced simultaneously by a southward electric field of order 2×10^4 e.m.u. (= 20 V/km), for a moderate magnetic variation of order 550γ. It is shown that the electrojet, with duration of order 1 hr, moves rapidly northward or southward. This would imply that the intensity of the electric field varies rapidly in time and place. It is inferred that the precipitation zone of high-energy electron beam varies in the same way. From these points of view, the dynamo theory is criticized and the origin of the electric field is discussed.

550.3

18468 INTERACTION OF THE SOLAR PLASMA WITH THE EARTH'S MAGNETIC FIELD. D.B.Beard.

Phys. Rev. Letters, Vol. 5, No. 3, 89-91 (Aug. 1, 1960).

It is shown how the magnetic field surrounding the earth is reshaped and terminated by the neutral flux of energetic electrons and protons emitted by the sun. A.Boksenberg

550.3 : 523.16

18469 SIMULTANEOUS OBSERVATIONS OF THE VARIATIONS IN THE HORIZONTAL COMPONENT OF THE EARTH'S MAGNETIC FIELD AND SOLAR RADIO EMISSION. R.N.Sedra, F.Fahmy and L.Sefien.

Proc. Math. Phys. Soc. Egypt, No. 22, 89-92 (June, 1958).

Using a saturated core magnetometer, the sudden variations in the horizontal component of the earth's field usually called "crochets" were recorded during the period June 1954 to Janu 1955. Solar radio bursts were recorded on the same chart on wave length of about 3.7 m. The sign of the magnetic disturba seems to agree with the diurnal magnetic variation which is a that magnetic "crochets" are intensifications of diurnal variat The time difference between the magnetic and solar disturban had a mean of 3.5 min.

550.3 :

18470 ON THE GREAT SOLAR FLARE WHICH STARTE 21 h 09 m, FEBRUARY 9TH, 1958, AS THE LIKEL SOURCE OF GEOMAGNETIC STORM, FEBRUARY 11TH. K.S

Rep. Ionosphere Res. Japan, Vol. 12, No. 1, 6-9 (March, 1958)

Storm occurrence probability data, based on solar flare a radio-emission parameters, indicate that the geomagnetic stor 11 Feb. 1958 was initiated by a Class 2 flare that occurred at 21 h 09 m on 9 Feb., 1958. Optical, radio, and geomagnetic dat three other flares are also tabulated. D.R.B

550.3 :

18471 PRELIMINARY REPORT ON THE EFFECT OF TH SOLAR ECLIPSE ON APRIL 19, 1958 ON THE GE MAGNETIC FIELD.

T.Rikitake, S.Uyeda, T.Yukutake, I.Tanaoka and E.Nakagawa.

Rep. Ionosphere Res. Japan, Vol. 12, No. 2, 174-81 (June, 195

Geomagnetic variations associated with this eclipse are analysed on the basis of the records obtained at Komoro, Abur and Hachijo-shima Island. The changes observed in the D and components are in good agreement with the theoretical ones, w are calculated by taking into account the decrease in the electr conductivity of the ionospheric E-layer in the eclipsed area. It also found that the changes in the Z component are strongly af by the local underground structure.

550.3 : 5

18472 EFFECT OF THE SOLAR ECLIPSE, 19th APRIL, ON THE GEOMAGNETIC FIELD AND EARTH CURRENTS. Y.Yamaguchi, N.Banno, H.Ōshima and T.Araki.

Rep. Ionosphere Res. Japan, Vol. 12, No. 2, 182-7 (June, 1958).

Observations on the geomagnetism and the earth current d this eclipse were made at Kakioka, Memambetsu and Kanoya. Mainly on the basis of these observations, the effects of the sol eclipse on the geomagnetic field are examined. The magnetic ditions during the solar eclipse were unfavourable and conclusi results can not be obtained. The observed results, however, a the same order as the values calculated under some appropriat assumptions.

550.3 : 551.5 : 523.2 : 5

18473 A UNIFIED THEORY OF TERRESTRIAL AND SOL MAGNETIZATION, THE OUTER VAN ALLEN BEL AND HIGH ENERGY PRIMARY COSMIC RAYS. V.A.Bailey.

J. atmos. terrest. Phys., Vol. 18, No. 2-3, 256-7 (June, 1960).

The hypothesis is based on the necessity for postulating an externally-produced magnetic field of ~0.01 G (at the earth) to account for the terrestrial magnetic field. It is shown that the of this field can be the solar motion with velocity of 30 km/sec relative to that of the earth if the sun carries a net charge of -2.2×10^{28} e.s.u. Some important consequences attached to the conception of a negatively-charged Sun as a source of the sepa produced magnetic field are indicated, more particularly in rel to the outer Van Allen belt and the primary cosmic-rays. Acco to the theory the field potential at the earth's orbital distance d the solar charge will be -4.4×10^{17} volts. The maximum kinet energy thus imparted to Fe nuclei, for example, will be 10^{19} eV which has the same order of magnitude as that of the maximum energies observed for the primary cosmic-ray particles.

D.R.Ba

550.3 : 5

18474 ON THE RELATION OF SOLAR ERUPTIONS TO GE MAGNETIC AND IONOSPHERIC DISTURBANCES. I. ON THE POWER SPECTRUM OF SOLAR RADIO OUTBURS K.Sinno and Y.Hakura.

Rep. Ionosphere Space Res. Japan, Vol. 12, No. 3, 285-95 (Sept. 1958).

The relation of solar eruptions to SWF (short wave fading) geomagnetic storms is investigated in connection with the three types of power spectrum of solar radio burst between 200 and 9400 Mc/s. Consequently, it is concluded that, as far as large are concerned: (1) the eruption with a solar radio burst ower spectrum is increasing towards lower frequencies cause an S_C-type magnetic storm, while it has little re- SWF (magnetic storm type); (2) the eruption with a burst ower spectrum is increasing towards higher frequencies always causes SWF, but has not any appreciable relation to etic storm (SWF type); (3) the eruption which has flat power m shows a combined effect of both types mentioned above, s to produce both SWF and a magnetic storm (combining type).

550.3 : 523.16

75 ON THE RELATION OF SOLAR ERUPTIONS TO GEOMAGNETIC AND IONOSPHERIC DISTURBANCES. THE TYPES OF SOLAR RADIO OUTBURSTS.
and Y.Hakura.
nosphere Space Res. Japan, Vol. 12, No. 3, 296-300 (Sept.,

lations between the variation of solar radio bursts on /s and geomagnetic storms are examined and the following sions are reached. Major bursts which have a pronounced rt before the maximum time of flares are closely related to nd those with a large second part (ordinarily corresponding IV, in spectral observation) correspond to a geomagnetic One can probably conclude that the second part of a major urst is direct evidence of the existence of the corpuscular hat would cause a geomagnetic storm.

550.8 : 534.6

LTRASONIC METHOD FOR THE EXPLORATION OF THE ERTIES AND STRUCTURE OF MINERAL LAYERS.
str. 16798

ATMOSPHERE . IONOSPHERE

(Abstracts on radiowave propagation in ionized media will also be found under Electromagnetic Waves)

551.5

76 A DISCUSSION ON THE RESULTS OF THE ROYAL SOCIETY'S EXPEDITION TO HALLEY BAY, RCTICA, DURING THE INTERNATIONAL GEOPHYSICAL
Roy. Soc. A, Vol. 256, 145-244 (June 21, 1960).
he discussion was held under the leadership of Sir Graham on 4th February 1960. After an introductory paper by the , eight papers were read and discussed. Abstracts of papers nt to geomagnetism, the ionosphere and the aurora will be in this or succeeding issues of Physics Abstracts.

551.5

177 ON THE APPLICATION OF NUMERICAL METHODS TO THE SOLUTION OF SYSTEMS OF PARTIAL DIFFER- AL EQUATIONS ARISING IN METEOROLOGY. J.Smagorinsky.
ers of numerical mathematics symposium, Wisconsin, 1959 bstr. 12232 of 1960) Paper Eight, p. 107-23.
he author surveys the history of dynamic meteorology down to me when large computers became avaibable. The application h computers is described and some difficulties pointed out. tressed that numerical solutions only supplement, and do not ce, analytical results on simple problems together with the laboratory analogues. 42 references. H.N.V.Temperley

551.5 : 539.16

ATMOSPHERIC CIRCULATION: DEDUCTIONS FROM FALL- ANALYSIS. See Abstr. 17513

551.5

478 CONTINUOUS RECORDING OF THE IONIC CONDUCTIVITY OF AIR NEAR THE GROUND.
lvador and H. Masson.
ys. Radium, Vol. 19, Suppl. No. 12, 124A-128A (Dec., 1958).
ench.
A current of air is made to flow through a cylindrical condenser uter electrode of which is earthed and the inner electrode essively connected to the + and – terminals of a battery via a resistance $R = 10^{11}$ ohms. The central electrode traps those small ions which are of opposite sign to itself, and this produces a difference in potential at the resistor terminals which is proportional to the magnitude it is required to measure. This voltage is then measured by means of a free-condenser type electrometer. The reading to be registered is obtained in 3 stages, as follows: (1) positive conductance; (2) negative conductance; (3) zero marking. This apparatus can be used either as an ion counter or as a conductance indicator, depending upon the velocity of the air flow.

551.5 : 537.56

18479 SMALL ION CHARACTERISTICS. Abdel-Fattah El-Nadi and F.I.Bessa.
Proc. Math. Phys. Soc. Egypt, No. 22, 27-42 (June, 1958).

Ions with mobilities in the range $(0.1 \le K \le 2)$ $cm^2 V^{-1} sec^{-1}$ were studied. Both divided and undivided cylindrical electrode condensers were used. The theory of both types is given and some of the practical curves which verify the theory are shown. The following conclusions were reached: (a) For accurate determination of the ion concentration the whole electrode method is preferable. (b) To obtain good resolution of the mobility groups the divided electrode method must be applied.

551.5

18480 ON THE EFFECT OF ORDINARY LIGHT ON SMALL ION CONCENTRATION. Abd El-Fattah El-Nadi.
Proc. Math. Phys. Soc. Egypt, No. 22, 59-63 (June, 1958).

Small ions formed by hard γ-rays showed a marked group of small ions of mean $k_- = 1.83$ $cm^2 V^{-1} sec^{-1}$ and mean $k_+ = 1.29$ $cm^2 V^{-1} sec^{-1}$. Visible light was found to decrease the concentration of ions by about 24%.

551.5

18481 SOLAR ACTIVITY AND THE ALTITUDE OF THE TROPOPAUSE NEAR THE EQUATOR. D.Stranz.
J. atmos. terrest. Phys., Vol. 16, No. 1-2, 180-2 (Oct., 1959).

A correlation has been shown to exist between the Zürich sunspot number and the altitude of the tropopause above Leopoldville, for the years 1953 to 1957. One or two examples are given which suggest that solar activity also influences other parameters of the upper troposphere. D.M.Schlapp

551.5

18482 THE GENERAL CIRCULATION OF THE ATMOSPHERE ABOVE 100 km AND THE LATITUDE EFFECT OF THE AIRGLOW. T.Hikosaka, B.Saitô and K.Yano.
Rep. Ionosphere Res. Japan, Vol. 12, No. 4, 472-4 (1958).

Roach (1955) has studied the latitude variation of airglow emission at 5577A and found that there is a zone of maximum excitation between 36° and 44°N latitude. From consideration of the various factors that contribute to the observed circulation of the terrestrial atmosphere above the 100 km level, the present authors conclude that it is possible to predict the latitude variation of airglow intensity when given a detailed analysis of the upper atmospheric circulation. Predicted and experimental data are compared, and are found to be in general agreement. D.R.Barber

551.5 : 525

18483 EFFECT OF UPPER ATMOSPHERE WIND ON THE ROTATION OF SATELLITE 1958δ1. C.R.Faulkner.
Nature (London), Vol. 187, 926-7 (Sept. 10, 1960).

Changes in the rotation of 1958 δ1 can apparently be explained by, and give additional evidence of, strong westerly wind in the upper atmosphere. A Boksenberg

551.5

18484 A CONVENIENT METHOD OF GETTING REPRESENTATIVE IONOSPHERIC HEIGHTS. G.A.M.King.
J. geophys. Res., Vol. 65, No. 5, 1623-4 (May, 1960).

Trace all h' versus f curves for the month on to one sheet of paper and draw a smooth median curve, counting perpendicular to this resultant representative h' versus f curve. D.M.Gilbey

551.5

18485 A NOTE ON FOURTH REFLECTION CONDITION IN THE IONOSPHERE. B.Chatterjee.
J. atmos. terrest. Phys., Vol. 17, No. 4, 271-5 (Feb., 1960).

Using a ray-optics argument, the author attempts to explain why there is no reflection of the extraordinary ray at a level where $\mu = \infty$ (the so-called "fourth reflection condition"). D.M.Schlapp

551.5

18486 A NEW MECHANISM FOR ACCELERATING ELECTRONS IN THE OUTER IONOSPHERE.
R.A.Helliwell and T.F.Bell.
J. geophys. Res., Vol. 65, No. 6, 1839-42 (June, 1960).

551.5

18487 IONOSPHERIC CONDITIONS IN THE CIRCUMPOLAR REGION (ACCORDING TO OBSERVATIONS, MADE AT THE DRIFTING STATION SP-3 DURING 1954-1955).
V.M.Driatski and A.S.Besprozvannaya.
Ann. Geophys., Vol. 14, No. 4, 438-55 (1958).

Ionospheric observations were made, mainly during the Arctic night.

551.5 : 525

18488 RADIO OBSERVATION OF THE EARTH SATELLITE 1957α. K.Miya, Y.Taguchi and S.Tabuchi.
Rep. Ionosphere Res. Japan, Vol 12, No. 1, 16-27 (March, 1958).

Observations were made of field intensity, bearing and Doppler shift of the 20 005 kc/s signal. It is concluded that ground scatter plays an important role in the propagation of the satellite's signal besides the space wave in the line-of-sight propagation and the ionospherically propagated waves.

551.5 : 621.391.812.42

18489 ANOMALOUS WINTER ABSORPTION OF RADIO WAVES. R.W.Morriss.
Proc. Phys. Soc., Vol. 75, Pt 6, 937-9 (June, 1960).

Measurements of the absorption of cosmic noise at a frequency of 24.3 Mc/s were made over the period January 1957 to May 1958. The average midday absorption in winter was found to be about twice as great as that in summer. The winter measurement conflicts with measurements of absorption made at 3 Mc/s if it assumed in both cases that $\nu^2 \ll (\omega + \omega_L)^2$ where ν is the electron collisional frequency and ω the frequency of observation. It is therefore concluded that the above expression is not valid at the lower frequency on most days in winter. This implies that on these days the absorbing electrons are largely concentrated near the level where $\nu \cong 2.6 \times 10^{-7}\ \mathrm{sec}^{-1}$ which is at a height of about 60 km.
C.Hazard

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18490 RADIO ECHOES FROM FIELD-ALIGNED IONIZATION ABOVE THE MAGNETIC EQUATOR AND THEIR RESEMBLANCE TO AURORAL ECHOES.
K.L.Bowles, R.Cohen, G.R.Ochs and B.B.Balsley.
J. geophys. Res., Vol. 65, No. 6, 1853-5 (June, 1960).

The main characteristics of v.h.f. radio echoes associated with equatorial sporadic E-layer ionization are described; and their similarity to the v.h.f. echoes that result from E-region auroral ionization is noted. Both types of echo show an aspect sensitivity that is weakly controlled by the geomagnetic field. This effect may be the result of local distortion of the earth's field caused by the flow of strong, localized ionospheric currents. D.R.Barber

551.5

18491 ANNUAL DISTRIBUTION OF SPORADIC-E.
N.C.Gerson.
J. atmos. terrest. Phys., Vol. 16, No. 1-2, 189-91 (Oct., 1959).

The frequency of occurrence of E_s over North America during 1949 was studied using 19 000 reports of v.h.f. radio contacts. The occurrence of E_s is almost entirely a summer phenomenon. Its geographical distribution over North America is given.
D.M.Schlapp

551.5

18492 E-REGION WINDS.
W.H.Ward.
J. atmos. terrest. Phys., Vol. 16, No. 3-4, 394-5 (Nov., 1959).

Conjectures are made on the consequences of the solar-heating theory of E-region winds.

551.5

18493 TRANSIENT FINE STRUCTURE OF THE E-LAYER.
W.Dieminger.
J. atmos. terrest. Phys., Vol. 16, No. 1-2, 179 (Oct., 1959).

Previous workers have maintained that the fine structure of the E-layer observed in rocket experiments does not show on ground-based ionograms taken simultaneously. Evidence is cited to show that the cause is a lack of sensitivity of the ground-based equipment. D.M.Schlapp

18494 THE IONOSPHERIC E-LAYER AT CAPE HALLE
G.A.M.King.
J. atmos. terrest. Phys., Vol. 16, No. 1-2, 186-7 (Oct., 1959

Experimental observations of the variations with solar ze
angle of f_0E in the range 1-2 Mc/s are compared with a theor
model of the atmosphere. Good agreement is obtained but f_0E
very sensitive to changes in the model. D.M.S

551.5 : 621.39

18495 A HIGHLY DIRECTIVE ROTATING ARRAY FOR
J.A.Thomas and R.W.E.McNicol.
Nature (London), Vol. 187, 398-9 (July 30, 1960).

A brief description of an aerial system for studying field-
aligned ionization in the F-region of the ionosphere. The effe
half-power beam width is 8° and the speed of rotation is one re
per 3 min. C.

18496 ECLIPSE EFFECTS ON THE F1-LAYER OBSERV
AT CAMBRIDGE ON 30 JUNE 1954. C.S.G.K.Set
J. atmos. terrest. Phys., Vol. 19, No. 2, 95-101 (Oct., 1960).

A study is made of the solar eclipse effects on the F1-la
observed at Cambridge on 30 June 1954, using the critical fre
cy data following the method developed by Minnis. The h'(f) r
were made during the period 26 June to 5 July 1954 using a pa
mic ionosphere recorder. Only a lower limit can be set for
recombination coefficient in the F1-layer and a value of 8 × 1
is not unsuitable. The major part of the radiation causing the
F1-layer ionization is almost uniformly distributed over the e
visible disk of the sun, except for some west limb brightening
explain a discontinuity in the eclipse variation of the critical f
cy, at 1330 hours. To fit the computed eclipse variation with
observed variation of the critical frequency, a source of radia
10% of the whole will have to be assumed to lie beyond the vis
disk of the sun.

18497 SOME STUDIES OF THE UPPER ATMOSPHERE
THE AURORAL ZONE. S.Matsushita.
Ann. Geophys., Vol. 14, No. 4, 483-91 (1958).

Relations between ionospheric and geomagnetic phenomen
auroral zone were studied from magnetograms and ionograms
made at the same station by correlating striking features in e
When a bay disturbance of moderate range occurred at night,
plete blanketing of F2 by sporadic E always happened at the ti
When the range of bays was larger, blackouts usually occurre
after the incidence of complete blanketing of F2. Slant E_s
occasionally appeared during bays, and it never occurred exce
during bays or bay-type variations during magnetic storms.
outs which occurred during daylight hours has no remarkable
correlations with geomagnetic variations except during magne
storms. In other words, there were two different types of the
blackout; night-time and daytime types. The height of the abs
region responsible for the polar blackout during daylight hours
seemed to be lower than that at night. In order to explain thes
results, the effect on the ionosphere of X-rays generated by th
primary particles from the sun are discussed. The cause of
magnetic bay disturbances is also considered.

18498 EFFECT OF ANNULAR SOLAR ECLIPSE OF 19th APRIL, 1958 (AT SUNRISE) ON THE F_2 LAYER OF IONOSPHERE. S.N.Mitra and B.C.Narasinga Rao.
Indian J. Phys., Vol. 33, No. 12, 540-5 (Dec., 1959).

Describes the effect of the annual solar eclipse of 19th Ap
1958 on the ionization density of the F_2 layer over Trivandrum.
Tiruchirapalli and Madras (South India). The eclipse occurred
sunrise at all the three places and its magnitude at maximum p
was 75 to 83%. Analysis of $(foF_2)^2$ values during control period
eclipse day showed a marked decrease in the ionization density
the progress of the eclipse at all the three places. Theoretical
considerations of the effect of an eclipse at sunrise on the ioni
density of the F_2 layer are discussed which have also led to the
determination of the value of attachment coefficient at 350 km
approximately $10^{-8}\ \mathrm{sec}^{-1}$ over Trivandrum.

18499 TEMPERATURE OF THE F2 REGION OF THE ION
SPHERE OVER KODAIKANAL. V.R.Venugopal.
Indian J. Meterorol. Geophys., Vol. 11, No. 3,295-7 (July, 1960

The noon temperature of the F2 region of the ionosphere o nal was computed by the scale height method for the months and December of 1953 and 1954, the period of low sunspot of the present solar cycle. The mean temperature at a f 400 km is found to be about 1500° K. It is also observed ter temperatures are higher than summer temperatures. mmer-to-winter warming up may be due to the winds in sphere.

551.5 : 523.74

0 A MONTHLY IONOSPHERIC INDEX OF SOLAR ACTIVITY BASED ON F2-LAYER IONIZATION AT N STATIONS. C.M.Minnis and G.H.Bazzard.

s. terrest. Phys., Vol. 18, No. 4, 297-305 (Aug. 1, 1960).

monthly index has been constructed, for the period 1938 to sing monthly mean or median noon values of f_0F2 at eleven -distributed stations. The correlation between f_0F2 at noon is index is significantly greater than that between f_0F2 and the 3 month weighted mean sunspot number or the monthly olar radio noise flux at 2800 Mc/s. Numerical estimates en made of the errors incurred in forecasting noon and ht f_0F2 several months ahead using these three indices as to the trend of solar activity.

551.5 : 621.391.812.63

01 SCATTERING OF RADIO WAVES BY ELECTRONS ABOVE THE IONOSPHERE. E.E.Salpeter.

hys. Res., Vol. 65, No. 6, 1851-2 (June, 1960).

e Abstr. 554B of 1959; Proc. Inst. Radio Engrs, Vol. 46, 1824-9, Nov., 1958). If α is the ratio of radio wavelength $\sin\frac{1}{2}\theta$, where D is the electron Debye length and θ the ing angle, then the frequency spectrum of scattered radar shows interesting features when α is comparable with unity. e definitions

$${}_{\beta}(\phi) = \{\exp(-\tfrac{1}{2}\phi^2)\}/\{\tfrac{1}{2}\pi\beta^2\phi^2\exp(-\phi^2) + [1+\beta^2-\beta^2 f(\phi/\sqrt{2})]^2\}$$

$$f(x) \equiv 2x\exp(-x^2)\int_0^x \exp t^2\,dt,$$

ction $F_\beta(\phi)$ represents the shape of the frequency spectrum 'electron component'' of the scattered wave, if $\beta = \alpha$ and $-\omega_0)/v_e\omega_0 2\sin\frac{1}{2}\theta$. Here ω and ω_0 are the frequencies of ed and incident radiation, c the velocity of light and v_e the hermal electron velocity. If the ions are singly charged ϕ also represents the shape of the "ion component" spectrum e substitution of v_i for v_e in the above expression for ϕ and $= \alpha(1+\alpha^2)^{-1/2}$. Suggestions are made for possible evaluation erimental backscatter spectra. D.M.Gilbey

551.5

502 GEOMAGNETIC PULSATIONS AND THE EARTH'S OUTER ATMOSPHERE. T.Obayashi.

eophys., Vol. 14, No. 4, 464-74 (1958).

ydromagnetic oscillations of the earth's ionized outer atmo- e along the geomagnetic lines of force are considered. The vational evidence of world-wide geomagnetic pulsations yields stribution of ionic density in the outer atmosphere extending d the ionosphere. It is found that the ion density is about 10^3 n^3 at a distance of a few earth radii decreasing exponentially alue of the order of 3 to 5 per cm^3 in interplanetary space. retical consideration on the temperature of the outer iono- e is also discussed.

551.5 : 537.59 : 550.3 : 523.2

UNIFIED THEORY OF TERRESTRIAL AND SOLAR MAGNETI- N, THE OUTER VAN ALLEN BELT AND HIGH ENERGY ARY COSMIC RAYS. See Abstr. 18473

551.5

03 ESCAPE OF HELIUM. D.R.Bates and M.R.C.McDowell.

os. terrest. Phys., Vol. 16, No. 3-4, 393-4 (Nov., 1959).

orrection is made to an earlier paper (Abstr. 782 of 1960) in the positive sign taken for the thermal diffusion factor was ect. The recomputed fluxes of helium escaping from the ere are considerably greater than the first results, but the ent against Spitzer's hypothesis is still quite strong.

D.M.Gilbey

551.5

504 ASSOCIATION BETWEEN AURORAE AND VERY-LOW-FREQUENCY HISS OBSERVED AT BYRD STATION, RCTICA. L.H.Martin, R.A.Helliwell and K.R.Marks.

e (London), Vol. 187, 751-3 (Aug. 27, 1960).

bservations made at Byrd Station, Antarctica, during 1959 indicate the existence of a close association between aurorae and v.l.f. hiss. The mid-frequency of the hiss-band appears to depend on auroral type: for example, red aurorae are associated with hiss of mid-frequency, 9.6 kc/s. Other workers (Duncan and Ellis, 1959) have previously reported a similar association. The origin of the v.l.f. radio emission is not yet understood. D.R.Barber

551.5

18505 LATITUDE DISTRIBUTION AND SEASONAL VARIATION OF AURORA OVER THE BRITISH ISLES DURING 1957 AND 1958. B.McInnes and K.A.Robertson.

J. atmos. terrest. Phys., Vol. 19, No. 2, 115-25 (Oct., 1960).

Visual auroral observations from the area of the British Isles for 1957 and 1958 are shown to give a latitude distribution which falls exponentially from the region of north Scotland southwards when plotted against geomagnetic inclination. The seasonal variation is shown to have March and September maxima.

551.5

18506 A STUDY OF AURORAL MOTIONS FROM ALL-SKY CAMERA RECORDS. B.K.Bhattacharyya.

Canad. J. Phys., Vol. 38, No. 10, 1279-90 (Oct., 1960).

A study of horizontal motions of visual aurorae as recorded by a 35 mm all-sky camera st Springhill (geographic 45.2° N., 75.5° W.; geomagnetic 56.6° N., 6.9° W.) near Ottawa has been carried out. The number of occurrences of motions in all the four geomagnetic directions, east, west, north, and south appears to reach its peak within a range of speed from 0 to 150 m/sec and tends to decrease with increase in speed. Very large speeds seem more frequently to be associated with motions to the west and to the south. The distribution curve of speed with the time of night appears to have two peaks, one before and another after midnight, in all the four cases. Auroral motion is predominantly westward in the early part of the night and eastward in the late hours of the night. The reversal of motion from westward to eastward direction seems to be a systematic process, the declining and inclining portions of the two curves as a function of time meeting each other somewhat before local midnight. Auroral speeds either along or perpendicular to geomagnetic parallels of latitude increase nearly linearly with the horizontal and vertical components of the magnetic disturbance vector.

551.5

18507 FURTHER OBSERVATIONS OF THE HORIZONTAL MOVEMENTS OF AURORA. J.A.Kim and B.W.Currie.

Canad. J. Phys., Vol. 38, No. 10, 1366-75 (Oct., 1960).

A previous paper (Abstr. 4599 of 1958) showed that systematic motions of aurora parallel and normal to the geomagnetic meridians could be deduced from successions of all-sky camera photographs. More reliable deductions which are based on a much larger number of observations, including some from a station inside the auroral zone, are reported. Both southward and northward speeds increase with geomagnetic latitude to the auroral zone where they become constant, or even decrease slightly, before continuing to increase inside the auroral zone. A seasonal variation of north—south speeds does not appear to exist. The diurnal variation of north—south speeds, dependent on geomagnetic latitude, is evident, the speeds decreasing to a minimum during the morning hours to the south of the auroral zone and increasing to a maximum during the same hours to the north of the zone. Large positive correlations exist between north—south speeds and departures of the magnetic field intensity from normal. East—west speeds either decrease or remain constant with increasing geomagnetic latitude. A significant seasonal variation of east—west speeds is not evident. Eastwards speeds are at a maximum between 03 and 04 hours L.M.T., and are associated with negative magnetic bays; westward speeds between 21 and 22 hours L.M.T., and are associated with positive magnetic bays.

551.5

18508 THE HEIGHT AND GEOMETRY OF AURORAL RADIO ECHOES. C.D.Watkins.

J. atmos. terrest. Phys., Vol. 19, No. 1, 1-9 (Sept., 1960).

The geometry of auroral radio echoes detected at Jodrell Bank with low sensitivity equipments (wavelength 4 m) is discussed. It has been found that echoes are only obtained from regions where the line of sight is within 1° of perpendicularity to the lines of force of the local magnetic field at a height of about 110 km, with a spread in height of the echo regions of not more than 5 km. This conclusion is in disagreement with the original interpretation of Bullough and Kaiser (1954) who proposed that the range-azimuth characteristics of the echoes arose from the alignment of the reflecting regions along geomagnetic latitudes. The new result agrees well with other observations carried out at Jodrell Bank on a wavelength of 8 m and with observations of the aurora australis carried out in Antarctica and New Zealand on shorter wavelengths. It is suggested that small differences in the location of the echo-regions arise from changes in the height of the regions and distortions of the lines of force during magnetic disturbances.

551.5

18509 ELEMENTARY PROCESSES IN THE UPPER ATMOSPHERE AND THEIR MANIFESTATION IN EMISSIONS.

I.S.Shklovsky.

Ann. Geophys., Vol. 14, No. 4, 414-24 (1958).

Discusses fluorescence of the upper atmosphere by selective absorption of u.v. radiation, and excitation of the Hα line in the aurora by high energy particles. The role of interplanetary gas is considered.

551.5

18510 THE NATURE OF EMISSIONS OF THE UPPER ATMOSPHERE. V.I.Krassovsky.

Ann. Geophys., Vol. 14, No. 4, 395-413 (1958).

Briefly discusses the theory of night-sky emissions, twilight and auroral. The following are dealt with: OH bands, the presence of atomic hydrogen in the upper atmosphere, 5577 and 6300 A [O I] emission, Na I emissions, continuous spectra, O_2 emission and auroral spectra.

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18511 LATITUDE EFFECT OF NIGHT AIRGLOW. J.Nakamura.

Rep. Ionosphere Space Res. Japan., Vol. 12, No. 4, 419-27 (1958).

In the Second Japanese Antarctic Research Expedition, the measurement of the intensity of the 5577 A emission was repeated, as in the first expedition, (Abstr. 14285 of 1960) on board the "Soya". The general tendency of the latitude effect was almost the same as in the first expedition. An analysis was made in order to classify the airglow intensity into two parts: the stormy airglow, which seems to be the effect of solar activity, and the stationary airglow which is generally weak and calm. The former has not much latitude effect; the latter shows a latitude effect besides a seasonal variation. The stationary airglow is weakest at the geographic equator, and it has secondary minima roughly between 35° and 40° of geographic latitude.

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18512 A PHOTOELECTRIC STUDY OF NIGHT SKY SPECTRA IN THE NEAR INFRARED. M.Dufay.

Ann. Geophys., Vol. 15, No. 2, 134-52 (1959). In French.

Spectra of the night sky and of aurorae in the near infrared were obtained, using a scanning spectrometer equipped with a rotating grating and a Lallemand photomultiplier (refrigerated Cs—O—Ag photocathode). The sensitivity of this apparatus is sufficient to obtain recordings of the 0.7-1.1 μ region with a spectral slit of 15 A and a scanning period of 45 min. Relative intensity measurements of the OH bands in this region are in reasonable agreement with the predicted intensity, except for the $v' = 9$ vibrational level. The intensity distribution in the P branches correspond to a rotational temperature of 250°K, in good agreement with other determinations. Nightly and seasonal variations of emission intensity were observed in the course of the year 1957. A noticeable correlation between intensity of the O_2 0-1 "atmospheric" band (8640 A) and the [OI] 5577 A green line was noted. Several low latitude aurorae were studied with the same instrument. The detected emission were principally atomic lines of OI and NI. The forbidden ^2D-^2P [NI] (10 400 A) and ^2D-^2P [OII](7320 A) doublets were also observed with a relatively great intensity.

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18513 THE 5577 A EMISSION OF [O I] IN THE NIGHT AIRGLOW FROM SACRAMENTO PEAK, NEW MEXICO.

E.R.Manring and H.B.Pettit.

Ann Geophys., Vol. 14, No. 4, 506-8 (1958).

A description of preliminary observations of the night sky made at Sacramento Peak on the 5577 A line from February 1955 to April 1957.

551.5

18514 NOTES ON THE NIGHTGLOW CONTINUUM NEAR λ5300A. T.Tohmatsu.

Rep. Ionosphere Res. Japan, Vol. 12, No. 2, 169-73 (June, 1958).

An analysis of the night-sky radiation near 5300A is made using the results of two-colour photometry of the oxygen green line [O I] 5577 and the night-sky background near 5300A. The con able change of brightness of the night-sky background from n night is mainly due to the existence of the nightglow continuun this spectral region. On ordinary nights, when the brightness [O I] 5577A is moderate, the night-sky radiation near 5300A i composed of 60 to 70 per cent of astronomical lights (faint sta galactic light and zodiacal light) and 30 to 40 per cent of the n glow continuum. The close correlation between the intensitie [O I] 5577 A and the nightglow continuum reported by Barbier (1955) is re-examined and confirmed. The height of the emitt layer, estimated by the "zenith to horizon method", is about 1 and is equal to the height of the [O I] 5577 A radiation.

18515 THE DYNAMICAL EFFECT ON THE INTENSITY NIGHTGLOW $[O_1]\lambda$5577. T.Tohmatsu.

Rep. Ionosphere Space Res. Japan, Vol. 12, No. 3, 253-67 (Sep 1958).

Chapman's excitation mechanism of the 5577 A radiation i nightglow is extended to a quantitative representation for find relevant connection between the theory and the observed facts this radiation. The dynamical actions in the upper atmospher well as the solar ultraviolet radiation, are likely to have an in tant influence on the spatial and time variation of λ5577. The elementary processes for the formation and disappearance of atomic oxygen are discussed by defining the "characteristic ti for each of these processes. The pressure effect on the emiss rate is formulated on the basis of gas reaction theory, in whic concept of adiabatic change of the emission rate is introduced. theory is tentatively applied to available observational results account for the solar cycle variations, the daily variation, the tude effect and the generation and decay of inhomogeneous patc of λ5577.

18516 RESEARCHES ON THE 6300 LINE OF THE NIGHT AIRGLOW. D.Barbier.

Ann. Geophys., Vol. 15, No. 2, 179-217 (1959). In French.

A large number of observations made at the Haute-Proven and Tamanrasset observatories are discussed. Results, some them entirely new, are given as follows: (1) Existence of a twi phenomenon, which can be observed in the direction of the azin of the sun, as long as this one is no more than 28°-30° under t horizon. This could be due to radiative dissociation of O_2, who scale height, in the 250-300 km range of altitudes, must be aro 70 km. During periods of solar activity, twilight emission is o very strong. (2) Electronic radiative recombination explains t intensity decrease observed at the beginning of the night. Mea height is 275 km. By comparison with ionospheric measureme the O_2 scale comes out to be 80 km. These results are valid d the winter months only. (3) The increase of intensity during th second half of the night is associated with a propagation along geomagnetic meridian. Its mean height is 230 km. (4) Bursts intensity are sometimes observed, during summer at the low altitude station of Tamanrasset. In winter there are so many such bursts that the variation of intensity in Tamanrasset has completely different character from the variation observed at Haute-Provence Observatory. (5) The Intensities 5557 and 630 do not show any correlation at the Haute Provence Observatory. not out of the question that bursts in Tamanrasset could have a weak counterpart on other radiations.

18517 SEASONAL VARIATIONS IN THE TWILIGHT ENHANCEMENT OF [OI] 5577.

L.R.Megill, P.M.Jamnick and J.E.Cruz.

J. atmos. terrest. Phys., Vol. 18, No. 4, 309-14 (Aug., 1960).

Measurements of the twilight enhancement of [OI] 5577 wer obtained during the period September 1957 to December 1958 a Rapid City, S.D. All these measurements were normalized to intensity at sunset or sunrise at a height of 100 km. The result obtained indicate that there was a seasonal dependence of the tw light enhancement of [OI] 5577 emission. The enhancement occu most frequently in the autumn and winter months, the maximum occurring about 1 November. The enhancement almost never occurred during the spring and summer months.

551.5

8 ON THE SCATTERING OF ULTRAVIOLET SOLAR RADIATION IN THE ATMOSPHERE WITH THE OZONE PTION CONSIDERED. S.H.H.Larsen.

. Publ., Vol. 21, No. 4, 44 pp. (1959).

attempt is made to give observational evidence for the ce of multiple molecular scattering and non-molecular ing of light in the ultraviolet region where the ozone absorp- very strong. An approximate method for calculating second- ttered light considering ozone absorption is developed and r analysing the observed data. Information about the effects iple molecular and non-molecular scattering processes has tained which should be taken into account when the vertical ution of the ozone in the atmosphere is deduced by the hr method".

551.5

819 THEORY OF THE SOLAR AUREOLE. II. APPLICATIONS TO ATMOSPHERIC MODELS. D.Deirmendjian.

eophys., Vol. 15, No. 2, 218-49 (1959).

e equation of radiative transfer for a moderately turbid phere, discussed in Pt I (Abstr. 6556 of 1958), is solved in a proximation, and the component of skylight contributed by large e scattering of sunlight at small angles is obtained. This compon- xpressed in a form that can be added directly to the known skylight corresponding to multiple scattering in a Rayleigh atmosphere appropriate optical thickness. A few simple aerosol models scribed; their general characteristics are similar to those of aerosols in number density, size distribution, and stratifica- particles, chosen so that the approximate scattering theory, d in Pt I, is applicable. The required normalization factor for ttering matrix and some other parameters are defined and ted in terms of the aerosol characteristics. Values of sky- tensity according to each model (assuming unit solar flux wavelengths) are then computed by the above method and are ted in various diagrams. These show that in the region 15' from the sun's limb, the skylight should have an intensity en times that at 10°, and that the brightness around the sun fall off with the cosecant of the angular distance. The blue of the sky should gradually change to white in the vicinity of n and the aureole should appear redder with increasing solar distance. The theoretical results are found to be in good nent with existing observations as to brightness gradient, um and even some polarization features. A further extension present theory is suggested to better explain the observed zation and position of neutral points. The conclusion is ed that a careful analysis of good aureole data is one of the ensitive tools of research in the investigation of atmospheric ity at all levels.

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1 20 BLUE HAZES IN THE ATMOSPHERE. F.W.Went.

(London), Vol. 187, 641-3 (Aug. 20, 1960).

easons are given why smoke, dust, water vapour and fog are out as causing the blue haze. Particles of 0.1 mμ or less reflect predominantly the blue rays and give a blue haze. must consist of an agglomeration of molecules caused by nsation in the air. From a comparison with the experiments dall and Hagen-Smit volatile substances from plants and trees nsidered. These are partially oxidized and with molecular h form particles which can be precipitated by rain and snow an also change colour. They exist over vegetated areas in an sion layer under Stcu and Acu clouds as wisps or veil clouds an act as condensation nuclei. The effect of blue haze and veil s on the heat balance of the atmosphere, the formation of erstorms and, on precipitation, as materials for petroleum tion are mentioned. R.S.Read

551.5 : 523.82

HEORY OF ASTRONOMICAL SCINTILLATION. See . 16548

551.5 : 535.33

TMOSPHERIC ABSORPTION SPECTRA IN THE FAR INFRA- USING TWO BEAM INTERFEROMETRY. See Abstr. 16837.

551.5

521 THE STRUCTURE OF THE ATMOSPHERIC ELECTRIC FIELD. T.Ogawa.

omagn. Geoelect., Vol. 11, No. 4, 139-47 (1960).

imultaneous records of the atmospheric electric potential gradient at three stations which formed a regular triangle with sides of about two km, were compared with each other during the period of January 8-13, 1956, including one cloudy day as well as the fine days. Expanding the daily course of the potential gradient on each day and at each station into Fourier series of 12 terms, the spectral distribution of the square of the amplitude of each component was obtained and the spectrum of the field was given by n^{-4} on an undisturbed day, n expressing the harmonic term. On theoretical grounds, assuming the distribution of space charge concentration characterized by its scale and its density within the lower layer of the atmosphere, it is suggested that the spectral distribution of field energy can be represented by n^{-7} in the intermediate range of n. The result was proved to be consistent with the analytical result. The factor causing the disturbance in the spectrum was looked for in the atmosphere using aerological data. It was found that the turbulent situation of the air in the lower altitudes up to three km controlled the structure of the atmospheric electric field.

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18522 TYPES OF DIURNAL VARIATION OF THE AIR—EARTH CURRENT. T.Ogawa.

J. Geomagn. Geoelect., Vol. 11, No. 4, 165-73 (1960).

The daily percentage variations of the air—earth current were calculated every 90° interval of longitude over the world, using the percentage variation of the potential of the upper conducting layer (atmospheric total potential) deduced from Carnegie measurements over the oceans, and that of the columnar resistance obtained from the measurements by Sagalyn and Faucher (Abstr. 9089 of 1959). The results generally represent the world-wide distribution of the measured daily variation curves which were arranged by Israël [Ann. Geophys., Vol. 10, 93 (1954)]. This fact generally indicates that the daily percentage variations of the columnar resistance at most stations over the land area are roughly equal, and also of the same magnitude as the universal daily percentage variation of the atmospheric total potential. However, more detailed discussions (obtained by comparing the measured and the calculated results at the urban district of the meridian 135° E) show that the daily variations of the air—earth current depend more on the local columnar resistance than the atmospheric total potential, the percentage variation of the former being twice as much as that of the latter. It is suggested that at the urban district the nuclei concentration in the lowest layer of the exchange layer plays an important part in the atmospheric electric current system.

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18523 STUDIES ON THE WAVEFORMS OF ATMOSPHERICS DURING THE REGULAR WORLD DAYS AND THE WORLD METEOROLOGICAL INTERVALS.

R.S.Srivastava and S.R.Khastgir.

J. sci. industr. Res., Vol. 18A, No. 9, 426-9 (Sept., 1959).

Some of the features of the waveforms of the atmospherics recorded at Banaras during the Regular World Days and the World Meteorological Intervals from June to October 1957 are discussed, and the automatic atmospherics recorder employed during the investigations is described. It was observed that the general character of the waveforms from near and distant sources changed only slightly during the Regular World Days with or without unusual meteoric activity, and also during the World Meteorological Intervals.

551.5

18524 ANALYSIS OF SMOOTH TYPE ATMOSPHERIC WAVE-FORMS. F.Hepburn.

J. atmos. terrest. Phys., Vol. 19, No. 1, 37-53 (Sept., 1960).

To resolve conflicting reports concerning smooth type waveforms, over 250 traces were extensively examined, as exemplifying wave-guide pulse dispersion. With very precise measurement, regular traces and those having various minor irregularities were distinguished. Over half the waveforms had regular traces and were directly explicable but analysis, accurate enough to give independent values of ionosphere height and propagation distance, was unattainable. Independent estimates of storm distances from a sferics network suggested unexpected constancy of ionosphere height at 83 ± 2 km by day and night. Amplitude analysis gave identical average source spectra for day- and night-time waveforms and indicated unsuspectedly trivial variations of attenuation with frequency in the range 4-10 kc/s, and for the day to night transition.

551.5

18525 THE PRODUCTION OF TRITONS AND C^{14} IN THE TERRESTRIAL ATMOSPHERE BY SOLAR PROTONS.

J.A.Simpson.

J. geophys. Res., Vol. 65, No. 5, 1615-16 (May, 1960).

An important part of the natural production rate of tritons may derive from the intense (10^4/cm^2 sec) fluxes (Reid and Leinbach, 1959; Anderson, Arnoldy, Hoffman, Peterson, and Winckler, 1959) of solar-flare protons, with energies not exceeding 1 BeV, at times near the maximum of the solar activity cycle. D.M.Gilbey

551.5

18526 THE THUNDER-STORM AS A CHEMICAL PHENOMENON. R.v.Konow.

J. Franklin Inst., Vol. 269, No. 6, 439-44 (June, 1960).

Many circumstances indicating chemical reactions are taken into consideration. For example, chemical changes of oxygen and water molecules in the air may promote the storage of electricity which discharges through lightning. Some chemical reactions are discussed which may be responsible for the accumulation of electricity.

5

18527 MEASUREMENTS OF ATMOSPHERIC OZONE AT SPITZBERGEN (78° N) AND TROMSÖ (70° N) DURIN THE WINTER SEASON. S.H.H.Larsen.

Geofys. Publ., Vol. 21, No. 5, 8 pp. (1959).

These results, based on moonlight observations during an observing period of 8 years, do not support the suggestion of Gö (1951) that an "ozone gap" should exist in December at high latit or even the often quoted minimum at this time of the year. A secondary rise in the annual period seems to appear during November. This may support the conventional view that differen solar heating of the ozone layer initiates a stratospheric jet stre in the Arctic.

551.5 : 53

EVAPORATION FROM WATER SURFACES COATED WITH FILM OF STEARYL ALCOHOL. See Abstr. 16922

BIOPHYSICS · PHYSIOLOGICAL PHYSICS

576.2

18528 EFFECTS OF ULTRASONIC IRRADIATION ON HEMOGLOBIN. A.Weissler.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1208-12 (Oct., 1960).

Oxyhaemoglobin in dilute aqueous solution is rapidly converted by ultrasonic irradiation into methaemoglobin, which in turn is gradually destroyed, as shown by the disappearance of its optical absorption peak at4050 A. Hematoporphyrin similarly suffers partial destruction by ultrasound. On the basis of experiments in various chemical environments, the previous results are ascribed largely to the nitrous and nitric acids produced by ultrasonic cavitation in water containing dissolved air. Adding 0.1 ml.ether/25 ml. of solution causes the sonochemical change to be from oxyhaemoglobin into carboxyhaemoglobin, instead of into methaemoglobin. Ultracentrifuge studies indicate that ultrasonic treatment of haemoglobin in more concentrated solution also causes some splitting off of the haeme from the globin. A comparison of the reported effects of X-rays on haemoglobin with those found for ultrasound shows that there are differences as well as similarities. The ultrasonic frequency used was 400 kc/s, and the acoustic power delivered into the reaction vessel in a focused beam was about 20 W.

Hearing . Speech

612.7

18529 ON THE MEASUREMENT OF PITCH DISTRIBUTION IN GERMAN SPEECH. W.Rappaport.

Acustica, Vol. 8, No. 4, 220-5 (1958). In German.

In males the frequency range extends from 70....120 c/s to 150...160 c/s — mean frequency about 120 c/s. In females the corresponding frequency range extends from 180....220 c/s to 300...330 c/s — mean frequency about 240 c/s. The pitch recorder of Grützmacher and Lottermoser [Akust. Zh., Vol. 2, 242 (1937)] has been developed by the author to give statistical results, and has been used in the determination of the statistical distribution of the fundamental pitch (the instantaneous frequency of the voice) of the speech of three groups of persons (German). Curves are shown in illustration. The maximum (statistically) for telephone speech (men) is 129 c/s, normal speech (men) 188 c/s, and telephone speech (women) is 238 c/s. A.B.Wood

612.7

18530 DETERMINATION OF THE SPECTRUM OF SPEECH BY A NEW METHOD. T.Tarnoczy.

Acustica, Vol. 8, No. 6, 392-5 (1958). In French.

The characteristic spectrum of speech was obtained by octave band analysis of the superposed recording of speech from up to 30 subjects. The spectrum of a musical instrument was obtained by 1/3 octave analysis of a recording made from the superposition of recordings of the instrument taken at different times.

H.D.Parbrook

6

18531 THE INTELLIGIBILITY OF RE-INFORCED SPEECH J.P.A.Lochner and J.F.Burger.

Acustica, Vol. 9, No. 1, 31-6 (1959).

Great progress has been made in the development of sound reinforcement systems but relatively little is known about the factors governing the success or failure of such systems when installed. In the recently developed delayed sound reinforcement system the illusion can be maintained that the sound is coming fr the talker and not from the loudspeakers by introducing an appro delay into the reinforcement circuit. In addition to a more natur quality, such a system can also furnish a higher intelligibility of speech than a straight reinforcement system. This is, however, always the case as such a system can also have a lower intelligi than a straight system. Using the recently determined integratio characteristics of the hearing mechanism as basis, some light is thrown on the factors governing the intelligibility of reinforced sp

61

18532 STANDARDIZATION OF SPEECH AUDIBILITY TESTING, SPEECH AUDIBILITY TRESHOLD AND SPEECH AUDIBILITY LOSS REFERENCE THRESHOLD.

F.J.Meister.

Acustica, Vol. 9, No. 1, 10-14 (1959). In German.

In reproducing groups of words as test pieces for hearing lo testing, a measurement of the sound level to a tolerance of ± 1.5 is undertaken from the point of view of average values for the vowels and peak values for the consonants. In tape recording of test words and their reproduction a correction of ± 5 dB is expe Proposals are made for standard amplitudes which can be used a references in this technique. The reference values are derived the whole field of response and not, as heretofore, from a single response curve.

61

18533 THE AUDIBILITY THRESHOLDS OF PULSES OF DIFFERENT DURATIONS.

R.Feldtkeller and R.Oetinger.

Akust. Beih. [Acustica], No. 2, 489-93 (1956). In German.

The hearing and masking thresholds for continuous tones, given as function of frequency are compared with the thresholds pulses, given as function of pulse duration. The masking threshol of tone pulses obey very simple laws. For pulses of very short duration, these thresholds become the same as for single pressur pulses. The masking thresholds of random noise pulses are a different function of pulse duration and thereby give an indication the ability of the hearing mechanism to be "trained" to subdivide continuous noise spectrum into frequency bands. It is necessary consider the "training" as starting anew with the onset of each ne pulse.

612.8

34 ON THE PITCH OF PERIODIC PULSES.

J.L.Flanagan and N.Guttman.

ust. Soc. Amer., Vol. 32, No. 10, 1308-19 (Oct., 1960).

bjects adjusted the frequency of one periodic pulse train to
the pitch of another train fixed in frequency. Two modes of
perception are found. In the first mode, for pulse rates less
00 pulses per sec, the pulse trains are ascribed a pitch
to the number of pulses per second, regardless of the pola-
attern of the pulses. In the second mode, for fundamental
ncies in excess of 200 c/s, the sounds are assigned a pitch
to the fundamental frequency. Between these frequency
s a mode transition occurs in which the pitch judgments
ally fall between the pulse-rate and fundamental-frequency
s. Amplitude and phase spectra are computed for the stimuli.
timuli are studied on an electrical analogue on the basilar
rane. Waveforms of membrane displacement and first spa-
erivative of displacement are obtained from the analogue.
ort is made to correlate the psychophysical results with the
cement and derivative patterns observed in the analogue
brane. The two pitch modes are found to be manifested in the
anical operation of the cochlea.

612.8

535 PITCH OF PERIODIC PULSES WITHOUT FUNDAMENTAL COMPONENT.

J.L.Flanagan and N.Guttman.

oust. Soc. Amer., Vol. 32, No. 10, 1319-28 (Oct., 1960).

The pitch of a periodic pulse train is matched to that of another
whose fundamental component of frequency is rejected. Three
s of pitch perception are found. The first obtains for pulse
less than 100 p.p.s. Here, in a manner similar to that found
ously for unfiltered stimuli, the pitches are matched to equate
rate, regardless of the polarity patterns of the trains. The
d mode occurs for fundamental frequencies in the approximate
200-500 c/s. Here there is a decided tendency to equate
mental frequencies. The third mode is manifested for funda-
al frequencies of the order of 1000 c/s and higher. In this
e subjects tend to equate the fundamental of the matching tone
e lowest spectral component present in the matched stimulus.
stimuli are studied with an electrical analogue of the basilar
brane. Waveforms of membrane displacement and first spa-
derivative of displacement are obtained from the analogue.
three (psychophysical) pitch modes are found to be manifested
ese mechanical functions of the basilar membrane.

612.8

3536 THE SPECIAL POSITION OF PERIODIC SHORT PULSES IN THE SENSITIVITY TO LOUDNESS.

H.Bauch.

st. Beih. [Acustica], No. 2, 494-511 (1956). In German.

The loudness of a series of Gaussian pulses and of a series of
nential pulses may be calculated from their amplitude spectrum
y desired level, provided that the repetition rate exceeds 10 c/s
the rise time $t_e > 0.12$ ms. The method of calculation is the
e as that developed earlier for the loudness calculation of con-
ous noise. The loudness of a single pulse is from 2 to 5 phons
, depending on pulse shape, than the loudness of a series of
es having the same shape and a repetition rate of 10 c/s. If the
time $t_e < 0.12$ ms the subjectively measured loudness is greater
calculated by the above mentioned method. This increased
sitivity of the hearing mechanism for short pulses is also ob-
ved when the hearing threshold is artificially altered by the use
andom noise. Finally, it is indicated how the loudness of Gaussian
es and exponential pulses may be estimated if their rise time is
than 0.12 ms.

612.8

18537 PSYCHOLOGICAL AND METHODICAL FOUNDATIONS FOR LOUDNESS.

E.Zwicker.

ust. Beih. [Acustica], No. 1, 237-58 (1958). In German.

Loudness measurements (halving and doubling) are made with
0 c/s tones, uniformly stimulating noise and white noise. The
ne sounds are also compared in loudness level. It is supposed
t a basic loudness function exists, which is responsible for the
nsation of both the loudness of sinusoidal tones and the loudness
noises. The determination of this loudness function is based on
assumption that the basic loudnesses are formed in the
opplungsbreiten" (corresponding to a length of 1.3 mm on the
gan of Corti) and that they are summed up to the total loudness
the brain. Since a sinusoidal tone produces a vibration of the
silar membrane over a wide range and stimulates the organ of
rti in a corresponding wide range, the loudness of a sinusoidal tone must already be composed of several partial loudnesses. Therefore it is not possible to calculate the loudness level of broad band noises with the help of the usual loudness curve of the 1000 c/s tone. The stimulation of the organ of Corti, which is assumed to be connected with the basical loudness by a power function, is determined from measured masking thresholds of narrow band noises and from the just noticeable differences of intensity. The exponent of the power function and, in connection with that, the function of the basic loudness is obtained from loudness level matching. The slope of the threshold at the low frequency end is ascribed to an increase of the inner fluctuation. The threshold produced by this fluctuation plays an important role for the basic loudness at low levels. Two control experiments indicate that the loudness of a tone of a narrow band noise is a composed loudness in fact. Results of the measurements and calculations made with the given method show good agreement.

612.8

18538 MONAURAL TEMPORAL MASKING INVESTIGATED BY BINAURAL INTERACTION.

N.Guttman, W.A.van Bergeijk and E.E.David, Jr.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1329-36 (Oct., 1960).

Three experiments were conducted to study monaural temporal masking as manifested in binaural interactions. The experimental paradigm consisted of presenting a pair of clicks in one ear and a single "probe" click in the other. The ability of listeners to bring the probe click into fusion with one or the other contralateral click served as the principal measure of masking. Forward masking (inability to fuse the second click) was studied as a function of repetition rate and click levels. The forward-masking interval increased with increase of first-click intensity and, notably, decreased with increase of repetition rate. For the conditions and procedure of this experiment, the longest forward-masking interval was about 7 msec. Backward masking (inability to fuse the first click) appeared when the monaural clicks were proximate (up to 2 msec in this experiment) and the second click was much more intense that the first. This type of backward masking was deemed a short-term effect and was distinguished from long-term backward masking. A model is presented to account for the improved resolution at high repetition rates.

612.8

18539 BINAURAL SUMMATION OF LOUDNESS.

G.S.Reynolds and S.S.Stevens.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1337-44 (Oct., 1960).

A stimulus of a given sound pressure sounds louder when it is heard with two ears than when it is heard with only one ear. This fact is demonstrated by a series of experiments designed to quantify the ratio of binaural to monaural loudness at various stimulus levels. The methods used included magnitude estimation, magnitude production, one-versus-two-ear ratio production, monaural—binaural loudness matching, and the cross-modality matching of loudness to the apparent intensity of a vibration. The results indicate that (1) monaural loudness grows as a power function of sound pressure with an exponent of about 0.54, whereas binaural loudness grows with an exponent of 0.6, and (2) the ratio between binaural and monaural loudness increases as a power function of sound pressure with an exponent of about 0.066. This ratio is 2 : 1 at about 90 dB S.P.L. At lower levels the ratio is smaller, and at higher levels it is larger.

612.8

18540 INVESTIGATIONS INTO THE DIFFERENCE-LIMENS FOR EXPONENTIAL DECAY OF NOISE-BAND PULSES.

H.P.Seraphim.

Akust. Beih. [Acustica], No. 1, 280-4 (1958). In German.

The difference-limens for exponential decay times of noise-band pulses were measured as well as their relationship to the reverberation time, the signal-to-noise ratio and the pitch range of the noise-band. The measurement was based on the "method of constant stimuli". Reverberation times in the commonly experienced range of 0.5-2s and 40 phons affect relative difference-limens by about 40%. Larger difference-limens, however, are obtained for shorter and longer reverberation times than the above. Changes in the signal-to-noise ratio (as long as the latter remains above 20 phons) have little effect. If, however, the signal-to-noise ratio is reduced below this value, the difference-limens increase rapidly. The pitch range of the noise-band has no effect.

612.8

18541 **ON THE "FORWARD–BACKWARD" IMPRESSION.** T.Tarnóczy.

Acustica, Vol. 8, No. 5, 343 (1958). In German.

Discusses briefly the effect of sounds proceeding from directly ahead or directly behind. Hitherto it has been regarded as impossible to decide (for a head fixed in position), as there is neither time difference nor intensity difference at the two ears. Reference is made to experiments on (a) 5 persons using normal hearing, (b) with tubes and (c) with artificial ears. In these cases the percent numbers of errors forwards and behind are (a) 22 : 9, (b) 47 : 33 and (c) 15 : 10 (before) 84 : 83 (behind). The author considers that the ear muscles play an important part. A.B.Wood

612.8

18542 **PSYCHOACOUSTICS AND DETECTION THEORY.** D.M.Green.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1189-1203 (Oct., 1960).

A review of detection theory as applied to certain psychoacoustic data. Detection theory is treated as a combination of two theoretical structures: decision theory and the concept of ideal observer. Statistical decision theory has been used to analyse the auditory threshold process. By treating the threshold process as an instance of hypothesis testing, two determinants of the process are recognized (1) the detectability of the signal and (2) the criterion level of the observer. The theory provides a technique of analysis which allows one to obtain a quantitative estimate of both factors. The measure of signal detectability appears to be independent of the psychophysical procedure when the physical parameters of signal and noise are held constant. The concept of ideal observer is reviewed with special emphasis on the assumptions of the derivation. The usefulness of this concept is illustrated by considering the shape of the psychophysical function — the function relating the detectability of the signal to its intensity. A rather general model based on the concept of signal uncertainty is presented which attempts to explain this relationship.

612.8

18543 **RESPONSE OF COCHLEAR MODELS TO APERIODIC SIGNALS AND TO RANDOM NOISES.** J.Tonndorf.

J. Acoust. Soc. Amer., Vol. 32, No. 10, 1344-55 (Oct., 1960).

Travelling bulges along the cochlear partition were recorded in response to gradual step-function signals (the simplest form of a transient). Such a bulge resembles a train of waves decaying both in time and in space. Since each half-wave grows longer in duration with its rank order, it forms its own individual envelope, including the location of maximal displacement. The latter location depends upon the time constant in essentially the same manner as that in response to steady-state signals upon inverse frequency. The point of over-all maximal displacement (usually due to the first half-wave) varies with the time constant of the applied signal but also with the signal shape. At any given point along the partition, the propagation velocity of each half-wave varies with the initial amplitude and its inverse time constant while its deceleration with distance depends upon the inverse time constant only. This is signified by the fact that the velocity-distance curves of various portions of each bulge tend to approach a common point which is frequently located beyond the helicotrema. The response to random noise (and to bands thereof) is a superposition, in time and in space, of responses to single transients in random distribution.

612.8

18544 **ILLUSIONS FROM AN ACOUSTIC ROOM IMPRESSION.** G.R.Schodder.

Akust. Beih. [Acustica], No. 2, 482-8 (1956). In German.

The purely acoustically induced sensation of a listener that he is in an enclosed space is to be ascribed to the echoes and the reverberation, coming to him from the various directions. Lauridsen has described a special form of reproduction; using headphones, which gives an acoustic room impression. A similar impression is given by a variant of a reproduction method due to Kock, in an anechoic room. Another system of Lauridsen's enhances the natural impression given by a room. All these reproduction methods involve frequency-independent phase shifts between the secondary sound waves falling on the left ear and the right ear and so correspond to frequency-dependent path differences. The hearing sense attributes to each frequency one or more definite directions of incidence of the sound.

Vision

18545 **THEORETICAL STUDY OF SPATIAL VISION. II.** N.Günther.

Optik, Vol. 17, No. 3, 168-76 (March, 1960). In German.

For Pt I, see Abstr. 12230 of 1960. The relations associati
accommodation distance and convergence distance with angle of
view are indicated. In addition, the "perception function" is
presented as an equation relating the object distribution in the
"physical" space to that in the "subjective" space. The signific
of this function is discussed.

6

18546 **THEORETICAL STUDY OF SPATIAL VISION. III.** N.Günther.

Optik, Vol. 17, No. 4, 185-91 (April, 1960). In German.

These formulae developed in Pt I and II are applied to the
problem of the elongation of an image arising from oblique obse
tion, which has been considered by Lau (Abstr. 1434 of 1960), a
to the physio-psychological effects in the nearer parts of the
"subjective" space.

6

18547 **THEORETICAL STUDY OF SPATIAL VISION. IV.** N.Günther.

Optik, Vol. 17, No. 5, 278-84 (May, 1960). In German.

The "perception function" is applied to the photogrammetri
problem of the degree of exaggeration encountered in the obser
tion of stereoscopic aerial photographs.

18548 **VISIBILITY OF A FINE LINE IN INTERMITTENT ILLUMINATION.** D.H.Fender and S.Mayne.

Optica Acta, Vol. 7, No. 2, 129-35 (April, 1960).

The visibility of a fine line in intermittent illumination
has been examined in detail for one subject. It is shown that
there are deviations from a regular response and that these
effects can be associated with certain physiological frequencies
exhibited by the subject, notably the tremor motions of the eyeb
and the α-rhythm of the subject's cortical activity.

6

18549 **PERCEPTUAL ANOMALIES ASSOCIATED WITH A SINGLE CONTOUR.** J.P.Wilson.

Nature (London), Vol. 187, 137 (July 9, 1960).

Experiments are described which indicate that a single cont
suffices to elicit a complementary image. R.A.W

6

18550 **THE GEOMETRY OF BINOCULAR VISION.** H.v.Schelling.

Optik, Vol. 17, No. 7, 345-64 (July, 1960). In German.

According to Luneburg the visual space is of a constant, no
vanishing Riemanian curvature. Under the assumption that the
visual space is defined by a distance function which is invariant
to affine transformations of physical Cartesian coordinates, it i
proved (1) that the sign of the curvature is negative, as expectec
by Luneburg, and (2) that completely determined, purely mathen
tical rules exist for mapping the momentary visual space into th
physical space. The mapping procedure deviates from methods
discussed by Luneburg and his followers. They depend on an
unknown function of a single variable which has to be found by
the application of psychological tests. The mapping is solved ex
citly for the three-dimensional case. The visual images of phys
perpendicular lines are computed. Various two-dimensional
examples are summarized graphically. The method can be gene
ralized to four dimensions, represented by Minkowski's coordin
(x,y.z; ict). A theory of the combined perception of space and ti
would be an analogue to the special theory of relativity.

6

18551 **SCANNING-MECHANISM HYPOTHESIS OF VISION.** H.P.Hovnanian.

J. Opt. Soc. Amer., Vol. 50, No. 9, 921 (Sept., 1960).

Qualitative evidence based on observing rotating propellers "with the sky as background" lead to the postulate of a "hitherto undetermined retinal scanning frequency". R.A.W

612.8

52 THE SPATIAL RESOLVING POWER OF THE HUMAN RETINA WITH OBLIQUE INCIDENCE.
ampbell and A.H.Gregory.
. Soc. Amer., Vol. 50, No. 8, 831 (Aug., 1960).

he grating acuity for three subjects was determined by using aunhofer diffraction fringes produced by a variable single-slit l close to the dilated pupil. Shifting the slit from the central to ripheral pupil reduced the acuity by factors of 2.9, 1.8, 1.5 various cases.

E.A.Mussett

612.8

553 SPECTRAL ENERGY THRESHOLDS FOR THE RESOLUTION OF ACUITY TARGETS.
rown, L.Phares and D.E.Fletcher.
t. Soc. Amer., Vol. 50, No. 10, 950-60 (Oct., 1960).

Threshold relative energy measurements have been made with chromatic light at 10 mμ intervals between 400 and 710 mμ for hold criteria which represent a series of visual acuities in ion to light detection. The data can be approximated by sum- cone and rod sensitivities derived from earlier independent urements of light detection by the dark-adapted eye in the . and the periphery. The relation between the logarithm of hold energy and visual acuity required by the criterion of hold has been predicted from monochromatic energy data for ral broad spectral distributions of illumination and predictions ompared with empirical data.

612.8

554 THEORY OF COLOR VISION.
R.M.Boynton.
t. Soc. Amer., Vol. 50, No. 10, 929-44 (Oct., 1960).

A theory of colour vision is presented which attempts to account he physics, physiology, and psychology of the colour vision ess. Three types of photopigments are assumed to be distrib- among five types of cones. It is suggested that colour signals of an opponent-colours variety from retina to lateral geniculate , then coded in terms of the four psychologically unique colours the lateral geniculate to the visual cortex. The theory is titative and provides an explanation of protanopia,deuteranopia, ritanopia. A new colour diagram is developed, based upon the lest version of the theory. Suggestions are made concerning this diagram might be modified to produce a more uniform ur space, and the meaning of such modifications is discussed rms of the theory.

612.8

8555 THEORY ON THE RECEPTOR MECHANISM IN COLOR VISION. A.C.Schroeder.
pt. Soc. Amer., Vol. 50, No. 10, 945-9 (Oct., 1960).

A theory is proposed to account for the colour discrimination he eye which does not require three different kinds of photo- micals or three different kinds of cones. Colour discrimination ccomplished by at least three identical receptors positioned at ropriate positions along the outer segment of each cone. Some mples of colour matching diagrams that can be obtained with this ry are compared with the C.I.E. colour matching diagram. Some ments are made indicating how it might be possible to get three arate signals from three receptors which are all within one cone.

612.8

8556 LINEARITY OF THE RELATIONSHIP BETWEEN THE TRISTIMULUS VALUES OF CORRESPONDING
LOURS SEEN UNDER DIFFERENT CONDITIONS OF CHROMATIC
PTATION. E.G.T.Wassef.
ca, Acta,Vol. 6, No. 4, 378-86 (Oct., 1959).

The hypothesis that the tristimulus values of the corresponding urs are linearly related is tested in three cases of chromatic ptation. Test colours illuminated by yellow, magenta and green ts are matched against Munsell samples under the illuminant a binocular viewer of improved design, and the elements of transformation matrices are calculated by the method of least ares. Scrutiny of the discrepancies between the values of the erved and the computed matches indicates that the hypothesis of arity holds in these cases as it did in the previously investigated es of adaptation to illuminants of continuous energy distributions. the strength of this evidence the invariant colours are calculated ach case using the geometrical properties of the affine trans- nation. The red and the blue invariants differ but little from the lier determinations. The third invariant still shows no inclina- to any particular region of the colour chart.

612.8

18557 WAVEGUIDE MODES: ARE THEY PRESENT, AND WHAT IS THEIR POSSIBLE ROLE IN THE VISUAL MECHANISM? J.M.Enoch.
J. Opt. Soc. Amer., Vol. 50, No. 10, 1025-6 (Oct., 1960).

The question is mooted whether waveguide modes may not play a role in colour vision.

R.A.Weale

612.8

18558 COLOR APPEARANCE SPECIFICATION WITH ADAPTATION TO DAYLIGHT AND TUNGSTEN ILLUMINATION. R.W.Burnham and R.J.Malach.
J. Opt. Soc. Amer., Vol. 50, No. 11, 1071-4 (Nov., 1960).

The Glasser et al. version of an Adams-type colour space has been evaluated for its capacity to take into account chromatic adaptation effects as they affect colour appearance. The study was concerned specifically with adaptation to C.I.E. sources C and A. The data of Burnham, Evans and Newhall (Abstr. 9253 of 1952) on matching colours under addaptation of these sources provided a basis for the test. It was concluded that colour space of this type must be used with caution as a means of representing colour appearance when adaptation to an illuminant other than source C is involved.

612.8

18559 EFFECT OF RED Vs WHITE ADAPTATION AND TARGET ILLUMINATION ON THE TEMPORAL COURSE OF SCOTOPIC ACUITY. S.M.Luria and I.Schwartz.
J. Opt. Soc. Amer., Vol. 50, No. 11, 1075-80 (Nov., 1960).

Curves are presented showing the times required for three observers to resolve a series of high contrast targets after initial adaptation to red or white light of 3.4 ft-L when the target luminances were 3.22, 3.82, 4.17, 4.77, and 5.13 log μμL. The resolution times were also measured as a function of three levels of red and white initial adaptation, 22, 3.4, and 0.19 ft-L, while the target luminance was held constant at 4.17 log μμL. In addition, a few measurements were made on low contrast targets at this last luminance. The curves generally conform with previous determinations, rising steeply at first and reaching an asymptote within ten minutes. The are sharply divided into two distinct groups, depending on the colour of the initial adapting light, red interfering less with the subsequent rise in acuity than white. The results indicate that the savings in time effected by the use of red rather than an equated white initial adapting light are not a function of the target illumination but remain approximately constant throughout the range of pure scotopic brightness at about 3 min. This decreased to about 2 min when the target luminance entered the mesopic range. Previous findings concerning the relation between target contrast and acuity, and that time savings with the use of red increase as the preadapting luminance increases, were confirmed.

612.8

18560 VARIABILITY OF DARK ADAPTATION.
E.Wolf, M.J.Zigler and H.B.Cowen-Solomons.
J. Opt. Soc. Amer., Vol. 50, No. 10, 961-5 (Oct., 1960).

Dark-adaptation curves were obtained from three observers: one was tested 15 times, the others 24 times each. Half of the tests were taken immediately upon entering the darkroom, the other half after 30 minutes rest in total darkness. The variability of threshold measurements is approximately twice as large in the former as in the latter condition. It appears that exposure to light prior to the standard procedure of testing exerts an influence upon subsequent threshold measurements, unless the visual receptor system is allowed to reach a state of equilibrium before the standard preexposure is given. This assumption is supported by experiments in which two observers spent half an hour reading under bright outdoor skylight. When the eyes are not shielded from high luminances, or when luminances, or when luminance is only slightly reduced, the delayed dark adaptation curves reach lower levels than when the tests are made immediately. However, when the eyes are shielded by dense goggles dark-adaptation curves obtained in immediate and delayed tests are indistinguishable. It seems probable, therefore, that variability in dark adaptation is at least in part a function of residual effects of exposure to light antecedent to routine preexposure and threshold measurements in dark adaptation tests.

612.8 : 628.971

18561 ACUITY OF VISION UNDER DIFFERENT KINDS OF LIGHT. P.Jainski.
Lichttechnik, Vol. 12, No. 7, 402-5 (July, 1960). In German.

The visual acuity of 11 observers of various ages was measured by the Landolt ring method with 5 different kinds of light, viz. W, Na, h.p.m.v., colour-corrected Hg and white fluorescent, the luminance levels ranging from 0.01 to 400 cd/m^2. The differences found were small, the range being about 25% at the highest luminance and 7% at the lowest. J.W.T.Walsh

612.8

18562 STUDIES ON DARK ADAPTATION. VII. EFFECT OF PRE-EXPOSURE COLOR ON FOVEAL DARK ADAPTATION. J.A.Hanson and E.M.S.Anderson.

J. Opt. Soc. Amer., Vol. 50, No. 10, 965-9 (Oct., 1960).

For Pt VI see Abstr. 14352 of 1960. Monocular absolute threshold curves were obtained for two observers with white, red, green, and blue test patches after white, red, green, and blue pre-exposures. All combinations of pre-exposure and test-patch colour were measured for each of two sizes of centrally fixated test patch : 48 min; and 2 deg 16 min. The pre-exposure field was centrally fixated and subtended 10°. The pre-exposure luminance and duration was 100 ft-lm for 100 sec prior to threshold determinations with the smaller test patch, and 10 ft-lm for 10 sec prior to threshold determinations with the larger test patch. The duration of the test flash was 0.033 sec. The results indicated the absence of pre-exposure colour effects in the rod-free fovea, with the exception that pre-exposure to red light reduced subsequent sensitivity to the long wavelength part of the spectrum to a slightly greater degree than did pre-exposure to any of the other colours tested. The results for the larger rod-populated foveal area demonstrated effects consistent with the scotopic luminance of the pre-exposure colours which were used.

612.8

18563 EFFECT OF TARGET VELOCITY IN A FRONTAL PLANE ON BINOCULAR SPATIAL LOCALIZATION AT PHOTOPIC RETINAL ILLUMINANCE LEVELS. A.Lit.

J. Opt. Soc. Amer., Vol. 50, No. 10, 970-3 (Oct., 1960).

Binocular settings of equidistance have been obtained in a two-rod test apparatus that provides real-depth cues. The magnitude of the localization error for a black vertical rod which oscillates in a given frontal plane has been studied as a function of target velocity at each of three specified photopic levels of binocular retinal illuminance. The direction of the localization error was opposite for the two observers used. For both observers, however, the absolute magnitude of the localization errors progressively increased as target velocity was increased at each of the three retinal illuminance levels. Also, retinal illuminance level has an effect on spatial localization. For both observers, the oscillating rod was localized at increasing distances from the eyes as level of retinal illuminance was increased at a given target velocity. These new data are discussed in relation to comparable data obtained in earlier experiments on depth settings for stationary targets and on depth settings for oscillating targets viewed under conditions of unequal binocular retinal illuminance (Pulfrich stereophenomenon).

612.8

18564 THE POSSIBLE ROLE PLAYED BY CONTRAST PHENOMENA IN THE DIFFERENCE BETWEEN SPECTRAL VISIBILITY CURVES DETERMINED BY THE DIRECT-COMPARISON AND FLICKER METHODS. G.Verriest.

Rev. Opt., Vol. 37, No. 10-11, 497-500 (Oct.-Nov., 1958). In French.

A comparison between foveal spectral sensitivity measurements obtained by heterochromatic matching and flicker methods, sho that the former yielded lower values at long wavelengths. This unlikely to be due to contrast. [The use of a 2° field and the lac information on the luminance level make one wonder whether th flicker method was not more effective in fully stimulating the e apparatus, some rods being indubitably stimulated in the matchi experiments.] R.A.W

18565 AN IMPROVED APPARATUS FOR PRODUCING A STABILIZED RETINAL IMAGE.

M.B Clowes and R.W.Ditchburn.

Optica Acta, Vol. 6, No. 3, 252-65 (July, 1959).

Criteria for defining the efficiency of an apparatus for stab the retinal image are formulated. A distinction is made betwee geometrical stabilization and stabilization of illumination. A ne technique is described which employs a telescopic normal incid system. This makes it possible to obtain geometrical compensa both for rotations and for translations of the eye. It also gives illumination stabilization. The degree of compensation achieved may be evaluated by precise physical measurements. About 99. of natural eye rotations in horizontal and vertical planes is compensated and the effect of translations is negligible. The apparatus is designed to permit easy interchange of normal and stabilized viewing conditions.

61

18566 NEURAL INHIBITORY UNITS OF THE EYE AND SK QUANTITATIVE DESCRIPTION OF CONTRAST PH MENA. G.v.Békésy.

J. Opt. Soc. Amer., Vol. 50, No. 11, 1060-70 (Nov., 1960).

Experiments on the skin show that it is convenient to use a "neural unit" for the description of some phenomena of sensatio magnitude that have been observed. The neural unit consists of area of sensation surrounded by a refractory area of inhibition. The paper tries to show how the numerical values for the unit ca be determined for the eye and skin and how they can be used in t description of Mach bands. In addition, step functions are descr from which it is possible to deduce two simple formulae for the culation of Mach bands. This procedure is very similar to the method used in telecommunication theory for the calculation of transients.

612.8 : 621.396.963

18567 PROBLEMS OF VISION IN A P.P.I. RADAR FIELD. L.Ronchi.

Atti Fond. Ronchi, Vol. 15, No. 3, 256-9 (May-June, 1960). In Italian.

A general discussion of the factors which affect performanc scanning a radar tube. The best luminance is about 0.1 ft-L and similar general luminance of the surroundings is advantageous. new work is reported, but conclusions reached by other investiga are given. J.W.T.Wa

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 62 (1959). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free. The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

A.E.I. Res. Lab. Repr.	A.E.I. Research Laboratory Reprint (Formerly: British Thomson-Houston Research Laboratory Publication) Associated Electrical Industries, Rugby.
Automat. remote Control	Automation and Remote Control Instrument Society of America, 313 Sixth Avenue, Pittsburgh 22, Pennsylvania. (A translation of the journal Avtomatika i Telemekhanika of the Academy of Sciences of the USSR [Avtomat. i Telemekh.])
Instrum. exper. Tech.	Instruments and Experimental Techniques Instrument Society of America, 313 Sixth Avenue, Pittsburgh 22, Pennsylvania. (A translation of the journal Pribory i Tekhnika Eksperimenta of the Academy of Sciences of the USSR [Pribory i Tekh. Eksper.])
Soviet Physics—Solid State (New York)	Soviet Physics—Solid State American Institute of Physics, 335 East 45th Street, New York 17, N.Y. (A translation of Fizika Tverdogo Tela [Fiz. tverdogo Tela]).

NEW JOURNAL

Quart. J. Roy. Astron. Soc.	Quarterly Journal of the Royal Astronomical Society (Successor to: Occasional Notes of the Royal Astronomical Society). Royal Astronomical Society, Burlington House, London, W.1. Vol. 1, No. 1, dated September, 1960.

CHANGE OF TITLE

B.T.-H. Res. Lab. Publ.	British Thomson-Houston Research Laboratory Publication Title changed to: A.E.I. Research Laboratory Reprint [A.E.I. Res. Lab. Repr.] in 1960
Occ. Notes Roy. Astron. Soc.	Occasional Notes of the Royal Astronomical Society Succeeded by: Quarterly Journal of the Royal Astronomical Society [Quart. J. Roy. Astron. Soc.]

ERRATA

Abstr. 9089 (1959) line 4: for "(Oct., 1958)" read "(Oct., 1956)".
Abstr. 1366 (1960) line 3: for "206-300" read "286-300".
Abstr. 11944 (1960) line 3: for "H.Watanake" read "H.Watanabe".
Abstr. 12233 (1960) line 2: for "WIENER-HOPE" read "WIENER-HOPF"
Abstr. 13400 (1960) insert journal reference: Phys. Rev., Vol. 119, No. 2, 691-3 (July 16, 1960).
Abstr. 15121 (1960) line 3: for "Ya.S.Uflyanol" read "Ya.S.Uflyand".
Abstr. 15611 (1960) line 3: for "H.Narum" read "H.Narumi";
line 4: for "(June, 1960)" read "(June, 1959)".
Author Index (Sept., 1960): for "Klyuskin,V.V., 13777" read "Klyushin,V.V., 13777".

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